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NAUTICAL ALMANAC
1868

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TENNENT'S

NAUTICAL ALMANAC

FOR THE PACIFIC COAST,

California Tide-Register,

AND

MARINE DIGEST,

FOR

1868.

By THOMAS TENNENT,

CHRONOMETER AND NAUTICAL INSTRUMENT MAKER.

SAN FRANCISCO:

A. ROMAN & COMPANY,

417 AND 419 MONTGOMERY ST.

NEW YORK: 17 MERCER STREET.

1868.

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PREFACE.

Encouraged by the success attending my two previous editions of the California Nautical Almanac and Tide Register, I determined, in the present edition for 1868, to enlarge it, by the introduction of full and complete Sailing Directions, at different seasons of the year, for the Coast of California, and particularly for entering the Harbor of San Francisco; also, the Harbor Regulations, Pilot Laws, and other matter deemed to be useful to Masters of vessels bound to this Port, together with various Maritime Laws, Rules, and Methods in Navigation, illustrated by examples, which would add to the value of the work, and make it a Digest of useful nautical information.

The Tables of High Water are carefully computed from reliable data furnished to me by the U. S. Coast Survey, and may be relied upon as correct. The quantities to be applied to obtain the time of High Water at points on the coast other than those given in the Tables, will be found by reference to the General Table of Tidal Constants.

Each succeeding edition of the Almanac will be improved by the insertion of such matter as may be considered convenient for ready reference by Shipmasters.

Thomas Tennent.

San Francisco, Cal., January, 1868.

CONTENTS.

Eclipses in 1868.
Morning and Evening Stars.
Equinoxes, Solstices, Chronological Cycles.
Sun Rising and Setting at San Francisco.
Moon Rising and Setting at San Francisco.
High Water at San Francisco, California.
High Water at Astoria, Oregon.
High Water at Port Townsend, Washington Territory.
The Sun's Declination at Apparent Noon, Greenwich; with Hourly Difference.
The Equation of Time, Greenwich; with Hourly Difference.
Table of Tidal Constants for Ports between San Francisco and Puget Sound.
Moon's Phases at Greenwich.
Lighthouses and important Headlands on West Coast United States.
Noonday Rock: position and bearings from Farallones and Point Reyes.
Rocks and Shoals in Pacific Ocean (Reports).
Table of Distances from San Francisco to Panama.
Table of Distances from San Francisco to Sitka.
Sailing Directions (General) for West Coast United States.
Sailing Directions (Special) for entering San Francisco Harbor.
Fog Signals in and about San Francisco Harbor.
Pilot Laws, San Francisco Harbor.
Harbor Regulations, San Francisco Harbor.
Police Regulations, San Francisco Harbor.
Passenger Act of State of California, Duty of Shipmasters in relation thereto, Liabilities, etc.
Act of Congress to prevent Collisions at Sea.
Act of Congress in regard to Lights and Fog Signals.
Hurricanes (Compiled).
Hurricanes: Rules to avoid them.
Thermometer: its Uses on approaching Ice or Land.
Barometer and Barometric Indications.
The Chronometer: General Instructions.
The Greenwich Date: Method of Finding, with Examples.
The Sun's Declination: to find and correct for any Meridian, from the Nautical Almanac, with Examples.
The Equation of Time: to find and correct for any Meridian, from the Nautical Almanac, with Examples.
Longitude at Noon from Equal Altitudes of the Sun, by Chronometer, with Examples.
Longitude and Apparent Time at Sunrise and Sunset, by Chronometer, with Examples.
Gain or Loss of Time in Circumnavigating the Globe, East or West, with Examples.

Eclipses in 1868.

In the year 1868 there will be two Eclipses, both of the Sun, and a Transit of Mercury over the Sun's disk.

I. An Annular Eclipse of the Sun, February 22–3, 1868, invisible in the United States.

Begins on the Earth, February 22d, 23^h $17^m.2$, Greenwich mean time, in longitude 78° 9.4′ west from Greenwich, and in latitude 12° 50.2′ south.

Central Eclipse begins on the Earth, 23d, 0^h $24^m.3$, in long. 94° 39.6′ west from Greenwich, and in lat. 11° 22.1′ south.

Central Eclipse at noon, 23d, 2^h $23^m.8$, in long. 32° 31.8′ west from Greenwich, and in lat. 5° 43.8′ south.

Central Eclipse ends on the Earth, 23d, 4^h $18^m.5$, in long. 334° 45.4′ west from Greenwich, and in lat. 19° 30.1′ north.

Eclipse ends on the Earth, 23d, 5^h $25^m.6$, in long. 351° 13.8′ west from Greenwich, and in lat. 18° 2.3′ north.

II. A Total Eclipse of the Sun, August 17th, 1868, invisible in the United States.

Begins on the Earth, August 17th, 14^h $34^m.6$, in long. 310° 33.9′ west from Greenwich, and in lat. 12° 4.3′ north.

Central Eclipse begins on the Earth, 15^h $29^m.2$, in long. 324° 0.9′ west from Greenwich, and in lat. 11° 12.8′ north.

Central Eclipse at noon, 17^h 13^m, in long. 257° 21.5′ west from Greenwich, and in lat. 10° 27.2′ north.

Central Eclipse ends on the Earth, 18^h $54^m.5$, in long. 196° 34.8′ west from Greenwich, and in lat. 16° 15.9′ south.

Eclipse ends on the Earth, 19^h $49^m.2$, in long. 210° 1.6′ west from Greenwich, and in lat. 15° 24.2′ south.

A Transit of Mercury over the Sun's disk, November 4th, 1868, invisible in the United States.

Morning and Evening Stars.

Venus will be Evening Star until July 16th, then Morning Star the rest of the year.

Mars will be Evening Star until January 2d, then Morning Star until November 13th, then Evening Star the rest of the year.

Jupiter will be Evening Star until March 10th, then Morning Star until July 4th, then Evening Star the rest of the year.

Saturn will be Morning Star until February 24th, then Evening Star until November 29th, then Morning Star the rest of the year.

Equinoxes and Solstices.

Vernal Equinox.....March 20	Summer Solstice.....June 20
Autumnal Equinox..September 22	Winter Solstice.....December 21

Chronological Cycles.

Dominical Letters.....E, D	Solar Cycle I
Epact 6	Roman Indiction.....II
Lunar Cycle, or Golden Number..7	Julian Period.....6581

JANUARY, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Small.	Large.	Small.	Large.	Small.	Large.
					A.M.	P.M.	A.M.	P.M.	P.M.	A.M.
Wed.	1	7 21	4 47	11 05	5 07	4 17	5 07	4 42	8 19	8 32
Thur.	2	7 21	4 47	morn	5 52	5 28	6 06	6 01	9 38	9 45
Frid.	3	7 21	4 48	0 03	large	small	large	small	large	small
Sat.	4	7 21	4 49	1 03	7 09	7 59	7 39	8 28	A.M.	10 51
Sun.	5	7 21	4 50	2 05	7 53	9 19	8 33	9 48	0 43	9 43
Mon.	6	7 21	4 51	3 08	8 32	10 32	9 23	10 58	2 26	10 26
Tues.	7	7 21	4 52	4 14	9 10	11 36	10 11	A.M.	3 49	11 11
Wed.	8	7 20	4 53	5 19	9 48	A.M.	10 53	0 06	4 59	P.M.
Thur.	9	7 20	4 54	rises	10 21	0 42	11 39	0 54	5 36	2 00
Frid.	10	7 20	4 55	6 38	11 11	1 21	P.M.	1 48	5 47	2 47
Sat.	11	7 20	4 56	7 49	P.M.	2 09	1 16	2 37	6 17	3 55
Sun.	12	7 20	4 57	8 59	1 01	2 54	2 06	3 23	6 48	5 08
Mon.	13	7 20	4 58	10 07	2 04	3 35	2 58	4 05	7 28	6 18
Tues.	14	7 19	4 59	11 10	3 18	4 18	4 01	4 45	8 10	7 36
Wed.	15	7 19	5 00	morn	4 36	5 08	5 11	5 28	8 52	8 54
Thur.	16	7 19	5 01	0 12	small	large	small	large	small	large
Frid.	17	7 19	5 02	1 13	7 12	6 39	7 45	7 02	9 52	A.M.
Sat.	18	7 19	5 03	2 10	8 25	7 22	8 58	7 58	10 00	0 06
Sun.	19	7 18	5 04	3 03	9 36	7 59	10 07	8 45	10 20	1 52
Mon.	20	7 18	5 05	3 59	10 36	8 36	11 08	9 34	10 48	3 12
Tues.	21	7 18	5 06	4 51	11 33	9 10	11 56	10 15	11 43	4 18
Wed.	22	7 17	5 07	5 38	A.M.	9 39	A.M.	10 57	P.M.	4 47
Thur.	23	7 17	5 08	6 24	0 14	10 16	0 37	11 28	1 37	5 08
Frid.	24	7 16	5 09	sets	0 50	11 02	1 17	P.M.	2 30	5 29
Sat.	25	7 15	5 10	6 12	1 23	11 49	1 54	0 57	3 27	5 44
Sun.	26	7 15	5 11	7 07	1 53	P.M.	2 25	1 40	4 19	5 59
Mon.	27	7 14	5 12	8 04	2 19	1 29	2 54	2 29	5 16	6 21
Tues.	28	7 13	5 13	8 59	2 44	2 20	3 19	3 14	6 16	6 42
Wed.	29	7 12	5 14	9 56	3 12	3 16	3 45	4 04	7 17	7 06
Thur.	30	7 12	5 15	10 55	large	small	large	small	large	small
Frid.	31	7 11	5 16	11 53	4 37	5 27	5 00	5 49	10 02	8 12

JANUARY, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	S. 23 2 41	12.0	3 36.6	1.19			
2	22 57 40	13.1	4 5.0	1.17			
3	22 52 12	14.2	4 33.0	1.16			
4	22 46 16	15.4	5 0.6	1.14			
5	22 39 54	16.5	5 27.8	1.12			
6	22 33 4	17.6	5 54.5	1.10			
7	22 25 48	18.7	6 20.8	1.08			
8	22 18 5	19.8	6 46.5	1.06			
9	22 9 55	20.9	7 11.8	1.04			
10	22 1 20	22.0	7 36.4	1.02			
11	21 52 19	23.1	8 0.6	0.99			
12	21 42 53	24.1	8 24.1	0.97			
13	21 33 1	25.2	8 47.1	0.94			
14	21 22 44	26.2	9 9.4	0.92			
15	21 12 2	27.2	9 31.1	0.89			
16	21 0 56	28 2	9 52.2	0 86			
17	20 49 26	29.2	10 12.5	0.83			
18	20 37 32	30.2	10 32.2	0.81			
19	20 25 14	31.2	10 51.2	0.78			
20	20 12 34	32.2	11 9 5	0.75			
21	19 59 31	33.1	11 27.0	0.72			
22	19 46 5	34 0	11 43 8	0.68			
23	19 32 17	34 9	11 59 9	0.65			
24	19 18 8	35.8	12 15.1	0 62			
25	19 3 37	36 7	12 29.6	0.59			
26	18 48 45	37.6	12 43.2	0 55			
27	18 33 33	38.4	12 56.1	0.52			
28	18 18 1	39.2	13 8.1	0.48			
29	18 2 9	40.1	13 19.3	0.45			
30	17 45 58	40.9	13 29.7	0.41			
31	17 29 28	41.6	13 39.2	0.38			

FEBRUARY, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Large.	Small.	Large.	Small.	Large.	Small.
					A.M.	P.M.	A.M.	P.M.	P.M.	A.M.
Sat.	1	7 10	5 17	morn	5 19	6 45	5 47	7 02	11 56	8 40
Sun.	2	7 09	5 19	0 54	6 02	8 02	6 38	8 13	A.M.	8 56
Mon.	3	7 08	5 20	1 56	6 47	9 13	7 36	9 31	1 23	8 45
Tues.	4	7 07	5 21	2 59	7 38	10 32	8 37	10 38	2 52	10 40
Wed.	5	7 06	5 22	4 02	8 25	11 25	9 40	11 49	3 38	P.M.
Thur.	6	7 05	5 23	5 03	9 17	A.M.	10 32	A.M.	4 03	1 03
Frid.	7	7 04	5 24	rises	10 06	0 15	11 20	0 43	4 46	2 24
Sat.	8	7 02	5 26	6 32	11 07	0 54	P.M.	1 27	4 52	3 12
Sun.	9	7 01	5 27	7 42	P.M.	1 41	1 08	2 15	5 23	4 13
Mon.	10	7 00	5 28	8 52	1 01	2 18	2 01	2 55	5 51	5 17
Tues.	11	6 59	5 29	9 57	2 01	2 51	2 54	3 28	6 22	6 24
Wed.	12	6 58	5 30	10 59	small	large	small	large	small	large
Thur.	13	6 57	5 31	11 59	4 15	4 12	4 49	4 42	7 37	8 51
Frid.	14	6 56	5 32	morn	5 34	4 57	5 59	5 22	8 07	10 21
Sat.	15	6 55	5 33	0 58	6 52	5 44	7 16	6 12	8 24	A.M.
Sun.	16	6 54	5 34	1 53	8 06	6 26	8 29	7 03	8 53	0 16
Mon.	17	6 52	5 36	2 46	9 16	7 07	9 41	7 56	9 31	1 45
Tues.	18	6 51	5 37	3 35	10 23	7 50	10 41	8 48	10 34	3 01
Wed.	19	6 50	5 38	4 21	11 11	8 29	11 33	9 42	11 36	3 38
Thur.	20	6 49	5 39	5 03	11 50	9 11	A.M.	10 26	P.M.	4 04
Frid.	21	6 48	5 40	5 42	A.M.	9 52	0 15	11 10	1 32	4 26
Sat.	22	6 47	5 41	6 19	0 23	10 49	0 51	11 54	2 29	4 46
Sun.	23	6 46	5 42	sets	0 49	11 35	1 23	P.M.	3 17	5 01
Mon.	24	6 45	5 43	6 53	1 18	P.M.	1 55	1 30	4 10	5 19
Tues.	25	6 43	5 44	7 51	1 41	1 17	2 19	2 14	5 05	5 36
Wed.	26	6 41	5 45	8 48	2 04	2 08	2 44	3 03	5 56	5 55
Thur.	27	6 40	5 46	9 47	large	small	large	small	large	small
Frid.	28	6 38	5 47	10 48	3 04	3 54	3 39	4 28	8 30	6 44
Sat.	29	6 37	5 48	11 48	3 45	5 11	4 16	5 31	10 19	7 08

FEBRUARY, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	S. 17 12 39	42.4	13 47.8	0.34			
2	16 55 32	43.1	13 55.7	0.31			
3	16 38 7	43.9	14 2.6	0.27			
4	16 20 25	44.6	14 8.8	0.24			
5	16 2 26	45.3	14 14.1	0.20			
6	15 44 11	46.0	14 18.6	0.17			
7	15 25 40	46.6	14 22.3	0.14			
8	15 6 53	47.3	14 25.1	0.10			
9	14 47 50	47.9	14 27.2	0.07			
10	14 28 33	48.5	14 28.5	0.04			
11	14 9 2	49.1	14 29.0	0.01			
12	13 49 16	49.7	14 28.8	0.03			
13	13 29 17	50.2	14 27.8	0.06			
14	13 9 4	50.8	14 26.0	0.09			
15	12 48 39	51.3	14 23.6	0.12			
16	12 28 1	51.8	14 20.4	0.15			
17	12 7 11	52.3	14 16.5	0.17			
18	11 46 9	52.8	14 12.0	0.20			
19	11 24 57	53.2	14 6.7	0.23			
20	11 3 33	53.7	14 0.8	0.26			
21	10 41 59	54.1	13 54.3	0.29			
22	10 20 15	54.5	13 47.1	0.31			
23	9 58 22	54.9	13 39.2	0.34			
24	9 36 20	55.3	13 30.8	0.36			
25	9 14 9	55.6	13 21.7	0.39			
26	8 51 50	56.0	13 12.0	0.41			
27	8 29 23	56.3	13 1.8	0.44			
28	8 6 48	56.6	12 51.0	0.46			
29	7 44 7	56.9	12 39.6	0.48			

MARCH, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Large.	Small.	Large.	Small.	Large.	Small.
					A.M.	P.M.	A.M.	P.M.	P.M.	A.M.
Sun.	1	6 36	5 49	morn	4 31	6 31	5 03	6 38	11 58	7 19
Mon.	2	6 34	5 50	0 49	5 20	7 46	5 59	7 54	A.M.	7 58
Tues.	3	6 33	5 51	1 50	6 13	9 07	7 03	9 04	1 27	9 15
Wed.	4	6 32	5 52	2 49	7 08	10 08	8 17	10 26	2 24	10 48
Thur.	5	6 31	5 53	3 45	8 08	11 06	9 23	11 34	3 06	P.M.
Frid.	6	6 29	5 54	4 37	9 05	11 53	10 18	A.M.	3 42	1 20
Sat.	7	6 27	5 55	5 25	9 57	A.M.	11 08	0 25	4 13	2 33
Sun.	8	6 26	5 56	rises	10 47	0 31	11 56	1 07	4 36	3 26
Mon.	9	6 25	5 57	7 35	11 54	1 01	P.M.	1 43	4 42	4 08
Tues.	10	6 23	5 58	8 41	P.M.	1 44	1 49	2 24	5 08	5 10
Wed.	11	6 21	5 59	9 44	small	large	small	large	small	large
Thur.	12	6 19	6 00	10 45	2 55	2 36	3 36	3 15	5 34	7 48
Frid.	13	6 18	6 01	11 42	4 07	3 05	4 34	3 49	5 39	9 31
Sat.	14	6 17	6 02	morn	5 28	3 41	5 42	4 21	6 07	10 59
Sun.	15	6 15	6 03	0 38	6 42	4 28	6 54	5 09	6 52	A.M.
Mon.	16	6 13	6 04	1 29	7 56	5 16	8 03	6 01	8 10	0 22
Tues.	17	6 11	6 05	2 17	8 57	6 02	9 09	7 04	9 27	1 14
Wed.	18	6 10	6 06	3 00	9 51	6 57	10 10	8 02	10 38	1 55
Thur.	19	6 08	6 07	3 42	10 35	7 53	11 01	9 01	11 44	2 30
Frid.	20	6 07	6 08	4 19	11 11	8 47	11 42	9 56	P.M.	2 58
Sat.	21	6 05	6 09	4 53	11 39	9 37	A.M.	10 45	1 40	3 19
Sun.	22	6 04	6 10	5 27	A.M.	10 25	0 14	11 49	2 35	3 42
Mon.	23	6 02	6 11	5 59	0 01	11 37	0 39	P.M.	3 27	4 01
Tues.	24	6 01	6 12	sets	0 24	P.M.	1 06	1 25	4 13	4 17
Wed.	25	6 00	6 12	7 41	large	small	large	small	large	small
Thur.	26	5 58	6 13	8 41	1 17	2 07	2 02	2 51	6 23	4 52
Frid.	27	5 56	6 14	9 43	1 39	3 05	2 28	3 43	7 59	5 01
Sat.	28	5 55	6 15	10 45	2 05	4 05	2 55	4 30	9 25	4 59
Sun.	29	5 53	6 16	11 45	2 44	5 10	3 31	5 26	10 47	5 25
Mon.	30	5 51	6 17	morn	3 39	6 33	4 24	6 25	11 47	6 09
Tues.	31	5 50	6 18	0 44	4 37	7 37	5 31	7 40	A.M.	7 35

MARCH, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	S. 7 21 19	57.1	12 27.7	0.51			
2	6 58 25	57.4	12 15.3	0.53			
3	6 35 25	57.6	12 2.4	0.55			
4	6 12 19	57 8	11 49.0	0.57			
5	5 49 9	58.0	11 35.1	0 59			
6	5 25 54	58.2	11 20.9	0.60			
7	5 2 35	58.4	11 6 2	0.62			
8	4 39 11	58.5	10 51.1	0.64			
9	4 15 45	58.7	10 35 6	0.65			
10	3 52 15	58 8	10 19.8	0.67			
11	3 28 42	58 9	10 3.7	0.68			
12	3 5 7	59.0	9 47 3	0.69			
13	2 41 29	59.1	9 30.6	0.70			
14	2 17 50	59.2	9 13.7	0.71			
15	1 54 10	59 2	8 56.5	0.72			
16	1 30 28	59 2	8 39.2	0.73			
17	1 6 46	59.3	8 21.6	0.73			
18	0 43 4	59.3	8 4.0	0 74			
19	S. 0 19 21	59.3	7 46.1	0.75			
20	N. 0 4 21	59 2	7 28.1	0.75			
21	0 28 2	59.2	7 10.0	0.76			
22	0 51 42	59.1	6 51.8	0.76			
23	1 15 20	59.1	6 33.6	0.76			
24	1 38 57	59.0	6 15 3	0.76			
25	2 2 31	58.9	5 56.9	0.77			
26	2 26 2	58.8	5 38.5	0.77			
27	2 49 31	58.6	5 20.1	0.77			
28	3 12 56	58.5	5 1.7	0.76			
29	3 36 17	58.3	4 43 4	0.76			
30	3 59 34	58.1	4 25 1	0.76			
31	4 22 47	57.9	4 6.8	0.76			

APRIL, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Large.	Small.	Large.	Small.	Large.	Small.
					A.M.	P.M.	A.M.	P.M.	A.M.	A.M.
Wed.	1	5 49	6 19	1 40	5 44	8 42	6 44	8 55	0 45	9 45
Thur.	2	5 47	6 20	2 32	6 56	9 44	7 59	10 06	1 37	11 15
Frid.	3	5 46	6 21	3 19	8 03	10 37	9 09	11 08	2 18	P.M.
Sat.	4	5 44	6 22	4 02	9 02	11 16	10 09	11 56	2 48	1 38
Sun.	5	5 43	6 23	4 41	9 58	11 48	11 01	A.M.	3 19	2 45
Mon.	6	5 42	6 24	rises	10 50	A.M.	11 52	0 28	3 44	3 46
Tues.	7	5 40	6 24	7 25	small	large	small	large	small	large
Wed.	8	5 39	6 25	8 27	P.M.	0 48	P.M	1 34	3 37	5 51
Thur.	9	5 38	6 26	9 27	2 00	1 12	2 42	2 04	3 29	7 21
Frid.	10	5 36	6 27	10 26	2 59	1 34	3 32	2 29	3 43	8 35
Sat.	11	5 35	6 28	11 20	4 00	1 59	4 23	2 59	4 14	9 44
Sun.	12	5 33	6 29	morn	5 14	2 34	5 17	3 30	5 24	10 28
Mon.	13	5 32	6 30	0 10	6 20	3 20	6 21	4 18	6 41	11 09
Tues.	14	5 30	6 31	0 57	7 19	4 20	7 23	5 14	8 03	11 55
Wed.	15	5 28	6 32	1 40	8 12	5 21	8 26	6 14	9 24	A.M.
Thur.	16	5 27	6 33	2 17	9 01	6 24	9 23	7 21	10 42	0 38
Frid.	17	5 26	6 34	2 52	9 42	7 27	10 12	8 26	11 45	1 14
Sat.	18	5 24	6 34	3 26	10 16	8 28	10 52	9 27	P.M.	1 47
Sun.	19	5 23	6 35	3 59	10 44	9 26	11 24	10 27	1 46	2 14
Mon.	20	5 22	6 36	4 30	11 07	10 20	11 49	11 19	2 36	2 36
Tues.	21	5 21	6 37	5 03	large	small	large	small	large	small
Wed.	22	5 20	6 38	sets	11 58	11 53	A.M.	P.M.	4 42	3 15
Thur.	23	5 18	6 39	7 32	A.M.	P.M.	0 50	2 05	6 09	3 20
Frid.	24	5 16	6 40	8 36	0 19	2 19	1 15	2 50	7 22	3 09
Sat.	25	5 15	6 41	9 38	0 45	3 11	1 47	3 42	8 29	3 22
Sun.	26	5 14	6 42	10 39	1 16	4 10	2 19	4 20	9 14	3 51
Mon.	27	5 13	6 43	11 37	1 59	4 59	3 04	5 13	10 03	5 02
Tues.	28	5 12	6 44	morn	3 08	6 06	4 01	6 12	10 58	6 27
Wed.	29	5 11	6 45	0 30	4 23	7 11	5 12	7 19	11 55	7 58
Thur.	30	5 09	6 45	1 18	5 37	8 11	6 32	8 31	A.M.	9 33

APRIL, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to *subtract* f'm Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	N. 4 45 55	57.7	3 48.6	0.75			
2	5 8 57	57.5	3 30.6	0.75			
3	5 31 54	57.3	3 12.6	0.74			
4	5 54 45	57.0	2 54.8	0.74			
5	6 17 30	56.8	2 37.2	0.73			
6	6 40 9	56.5	2 19.7	0.72			
7	7 2 40	56.2	2 2.4	0.71			
8	7 25 5	55.9	1 45.4	0.70			
9	7 47 22	55.6	1 28.7	0.69			
10	8 9 31	55.2	1 12.2	0.68			
11	8 31 31	54.9	0 56.0	0.67			
12	8 53 24	54.5	0 40.1	0.66			
13	9 15 8	54.1	0 24.6	0.64			
14	9 36 42	53.7	0 9.3	0.63			
15	9 58 7	53.3	0 5.6	0.61			
16	10 19 23	52.9	0 20.0	0.59			
17	10 40 28	52.5	0 34.1	0.58			
18	11 1 23	52.1	0 47.8	0.56			
19	11 22 7	51.6	1 1.0	0.54			
20	11 42 40	51.1	1 13.9	0.53			
21	12 3 1	50.6	1 26.3	0.51			
22	12 23 11	50.1	1 38.2	0.49			
23	12 43 8	49.6	1 49.7	0.47			
24	13 2 53	49.1	2 0.7	0.45			
25	13 22 25	48 6	2 11.3	0.43			
26	13 41 44	48.0	2 21.4	0.41			
27	14 0 49	47.4	2 31.0	0.39			
28	14 19 41	46.9	2 40.1	0.37			
29	14 38 18	46.3	2 48.7	0.35			
30	14 56 41	45.6	2 56 8	0.33			

MAY, 1868.

Day of Week.	Day of Month.	*San Francisco.* Sun rises.	Sun sets.	Moon sets.	HIGH WATER Large.	Small.	*Astoria.* HIGH WATER Large.	Small.	*Port Townsend.* HIGH WATER Large.	Small.
					A.M.	P.M.	A.M.	P.M.	A.M.	A.M.
Frid.	1	5 08	6 46	2 01	6 51	9 05	7 48	9 35	0 42	11 32
Sat.	2	5 07	6 47	2 41	8 02	9 52	9 00	10 27	1 25	P.M.
Sun.	3	5 06	6 48	3 18	9 05	10 29	10 06	11 13	1 57	1 59
Mon.	4	5 05	6 49	3 54	10 03	10 59	11 01	11 44	2 22	2 48
Tues.	5	5 04	6 50	4 30	small	large	small	large	small	large
Wed.	6	5 03	6 51	rises	11 41	11 51	P.M.	A.M.	3 07	5 21
Thur.	7	5 02	6 52	8 03	P.M.	A.M.	1 41	0 50	2 24	6 16
Frid.	8	5 01	6 53	9 09	1 53	0 30	2 30	1 28	2 34	7 26
Sat.	9	5 00	6 54	10 01	2 47	0 53	3 18	1 57	2 57	8 27
Sun.	10	4 59	6 55	11 01	3 44	1 21	4 01	2 25	3 56	9 00
Mon.	11	4 58	6 56	11 35	4 40	1 50	4 59	3 02	5 08	9 36
Tues.	12	4 57	6 57	morn	5 39	2 40	5 43	3 52	6 21	10 13
Wed.	13	4 56	6 58	0 16	6 34	3 41	6 40	4 34	7 39	10 53
Thur.	14	4 55	6 59	0 52	7 23	4 46	7 34	5 35	9 00	11 32
Frid.	15	4 55	6 59	1 26	8 07	5 49	8 29	6 37	10 12	A.M.
Sat.	16	4 54	7 00	1 58	8 48	6 53	9 17	7 44	11 24	0 14
Sun.	17	4 53	7 01	2 28	9 25	7 58	10 01	8 52	P.M.	0 50
Mon.	18	4 52	7 02	3 01	9 56	9 01	10 37	9 56	1 24	1 19
Tues.	19	4 51	7 03	3 34	large	small	large	small	large	small
Wed.	20	4 51	7 03	4 09	10 54	10 49	11 43	11 44	3 40	2 07
Thur.	21	4 50	7 04	4 48	11 14	11 44	A.M.	P.M.	5 10	2 18
Frid.	22	4 49	7 05	sets	11 43	P.M.	0 12	1 47	6 20	2 10
Sat.	23	4 49	7 05	8 29	A.M.	1 43	0 47	2 42	7 26	2 20
Sun.	24	4 48	7 06	9 29	0 16	3 10	1 23	3 24	8 03	2 48
Mon.	25	4 48	7 06	10 26	0 51	3 51	2 05	4 14	8 44	3 51
Tues.	26	4 47	7 07	11 17	1 44	4 42	2 50	5 01	9 33	5 08
Wed.	27	4 46	7 08	morn	2 57	5 45	3 49	5 56	10 25	6 33
Thur.	28	4 46	7 08	0 03	4 13	6 47	5 01	7 00	11 16	8 03
Frid.	29	4 45	7 09	0 44	5 28	7 42	6 17	8 04	A.M.	9 36
Sat.	30	4 44	7 10	1 22	6 41	8 31	7 31	8 58	0 06	11 32
Sun.	31	4 44	7 10	1 57	7 52	9 16	8 47	9 54	0 46	P.M.

MAY, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* f'm Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	N.15 14 49	45.0	3 4.4	0.30			
2	15 32 42	44.4	3 11.4	0.28			
3	15 50 19	43.7	3 17.9	0.26			
4	16 7 41	43.1	3 23.9	0.24			
5	16 24 46	42.4	3 29.4	0.21			
6	16 41 35	41.7	3 34.3	0.19			
7	16 58 8	41.0	3 38.6	0.17			
8	17 14 23	40.3	3 42.3	0.14			
9	17 30 22	39.6	3 45.5	0.12			
10	17 46 3	38.8	3 48.1	0.09			
11	18 1 26	38.1	3 50.0	0.07			
12	18 16 31	37.3	3 51.4	0.04			
13	18 31 18	36.6	3 52.2	0.02			
14	18 45 46	35.8	3 52.4	0.00			
15	18 59 55	35.0	3 52.1	0.03			
16	19 13 45	34 2	3 51.1	0.05			
17	19 27 16	33.4	3 49.6	0.08			
18	19 40 26	32.5	3 47.5	0.10			
19	19 53 17	31.7	3 44.8	0.12			
20	20 5 48	30.8	3 41.6	0.15			
21	20 17 58	30.0	3 37.8	0.17			
22	20 29 48	29.1	3 33.5	0.19			
23	20 41 16	28.2	3 28.6	0.21			
24	20 52 23	27.3	3 23.3	0.23			
25	21 3 8	26.4	3 17.4	0.25			
26	21 13 32	25.5	3 11.1	0.27			
27	21 23 34	24.6	3 4.3	0.29			
28	21 33 14	23.7	2 57.1	0.31			
29	21 42 31	22.7	2 49.5	0.33			
30	21 51 25	21.8	2 41.4	0.34			
31	21 59 57	20.8	2 32.9	0.36			

JUNE, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Small.	Large.	Small.	Large.	Small.	Large.
					A.M.	P.M.	A.M.	P.M.	A.M.	P.M.
Mon.	1	4 44	7 11	2 30	8 55	9 37	9 51	10 24	1 16	2 30
Tues.	2	4 44	7 11	3 07	10 02	10 12	10 56	11 09	1 25	3 39
Wed.	3	4 43	7 12	3 42	10 59	10 33	11 47	11 34	1 36	5 28
Thur.	4	4 43	7 13	rises	11 54	10 54	P.M.	A.M.	1 28	6 20
Frid.	5	4 43	7 13	7 54	P.M.	11 39	1 40	0 16	1 15	6 45
Sat.	6	4 43	7 14	8 45	1 58	A.M.	2 22	0 47	2 07	7 11
Sun.	7	4 43	7 15	9 31	2 41	0 04	3 02	1 23	3 05	7 33
Mon.	8	4 42	7 16	10 13	3 20	0 41	3 43	1 55	4 05	7 57
Tues.	9	4 42	7 16	10 51	4 00	1 22	4 20	2 34	5 11	8 25
Wed.	10	4 42	7 17	11 26	4 45	2 12	4 59	3 15	6 22	8 54
Thur.	11	4 42	7 17	11 58	5 34	3 11	5 46	4 02	7 31	9 33
Frid.	12	4 42	7 17	morn	6 17	4 20	6 31	5 01	8 45	10 11
Sat.	13	4 42	7 18	0 31	6 58	5 27	7 20	6 06	10 02	10 52
Sun.	14	4 42	7 18	1 00	7 36	6 34	8 05	7 15	11 08	11 34
Mon.	15	4 42	7 18	1 31	large	small	large	small	large	small
Tues.	16	4 42	7 19	2 05	8 59	8 40	9 45	9 28	P.M.	A.M.
Wed.	17	4 43	7 19	2 41	9 28	9 49	10 22	10 34	3 20	0 23
Thur.	18	4 43	7 19	3 24	9 56	10 54	10 58	11 37	4 35	0 20
Frid.	19	4 43	7 20	4 12	10 26	11 56	11 33	P.M.	5 40	0 35
Sat.	20	4 43	7 20	sets	11 01	P.M.	A.M.	1 28	6 12	1 02
Sun.	21	4 43	7 20	8 14	11 48	1 55	0 19	2 28	6 43	2 00
Mon.	22	4 43	7 20	9 09	A.M.	2 48	1 03	3 14	7 16	3 07
Tues.	23	4 44	7 20	9 59	0 38	3 26	1 49	3 56	7 53	4 16
Wed.	24	4 44	7 20	10 44	1 37	4 11	2 40	4 39	8 37	5 31
Thur.	25	4 44	7 20	11 23	2 49	5 03	3 38	5 25	9 25	6 57
Frid.	26	4 44	7 21	11 59	4 08	5 58	4 49	6 16	10 15	8 15
Sat.	27	4 45	7 21	morn	5 24	6 48	6 05	7 12	11 02	9 41
Sun.	28	4 45	7 21	0 35	small	large	small	large	small	large
Mon.	29	4 45	7 21	1 09	7 56	8 06	8 42	8 55	11 46	P.M.
Tues.	30	4 46	7 21	1 44	9 07	8 41	9 50	9 37	11 44	2 00

JUNE, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* from / *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
			M. S.	S.			
1	N.22 8 6	19.9	2 24.0	0.38			
2	22 15 52	18.9	2 14.7	0.39			
3	22 23 14	17.9	2 5.1	0.41			
4	22 30 13	16.9	1 55.1	0.42			
5	22 36 48	16.0	1 44.8	0.44			
6	22 42 59	15.0	1 34.2	0.45			
7	22 48 47	14.0	1 23.3	0.46			
8	22 54 10	13.0	1 12.0	0.47			
9	22 59 10	12.0	1 0.5	0.48			
10	23 3 45	11.0	0 48.8	0.49			
11	23 7 56	9.9	0 36.8	0.50			
12	23 11 42	8.9	0 24.6	0.51			
13	23 15 4	7.9	0 12.1	0.52			
14	23 18 2	6.9	0 0.4	0.53			
15	23 20 35	5.9	0 13.1	0.53			
16	23 22 43	4.8	0 26.0	0.54			
17	23 24 27	3.8	0 38.9	0.54			
18	23 25 45	2.8	0 52.0	0.54			
19	23 26 39	1.7	1 05.1	0.55			
20	23 27 8	0.7	1 18.1	0.55			
21	23 27 13	0.3	1 31.2	0.54			
22	23 26 52	1.4	1 44.2	0.54			
23	23 26 7	2.4	1 57.2	0.54			
24	23 24 57	3.4	2 10.1	0.53			
25	23 23 22	4.5	2 22.8	0.53			
26	23 21 23	5.5	2 35.4	0.52			
27	23 18 59	6.5	2 47.9	0.51			
28	23 16 11	7.5	3 0.1	0 50			
29	23 12 58	8.5	3 12.1	0.50			
30	23 9 20	9.6	3 23.9	0.48			

JULY, 1868.

Day of Week.	Day of Month	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Small.	Large.	Small.	Large.	Small.	Large.
					A.M.	P.M.	A.M.	P.M.	P.M.	P.M.
Wed.	1	4 46	7 21	2 23	10 13	9 13	10 56	10 23	11 55	3 36
Thur.	2	4 47	7 21	3 03	11 13	9 47	11 49	10 56	A.M.	4 47
Frid.	3	4 47	7 20	3 46	P.M.	10 11	P.M.	11 40	0 18	5 22
Sat.	4	4 48	7 20	rises	0 57	10 57	1 21	A.M.	1 09	5 37
Sun.	5	4 48	7 20	8 02	1 40	11 42	2 07	0 14	2 23	6 15
Mon.	6	4 49	7 20	8 51	2 13	A.M.	2 42	0 58	3 19	6 33
Tues.	7	4 49	7 19	9 27	2 43	0 25	3 13	1 37	4 18	6 50
Wed.	8	4 50	7 19	10 10	3 12	1 09	3 44	2 16	5 10	7 12
Thur.	9	4 50	7 19	10 32	3 43	1 58	4 10	2 59	6 17	7 43
Frid.	10	4 51	7 18	11 01	4 22	2 53	4 43	3 45	7 24	8 14
Sat.	11	4 52	7 18	11 33	5 02	3 58	5 22	4 38	8 27	8 53
Sun.	12	4 52	7 18	morn	large	small	large	small	large	small
Mon.	13	4 53	7 17	0 04	6 30	6 10	7 04	6 46	11 18	9 56
Tues.	14	4 54	7 17	0 38	7 09	7 20	7 52	7 53	P.M.	10 05
Wed.	15	4 54	7 16	1 16	7 50	8 35	8 46	9 07	2 32	10 32
Thur.	16	4 55	7 16	2 00	8 33	9 50	9 37	10 21	3 45	11 07
Frid.	17	4 56	7 15	2 51	9 11	10 59	10 37	11 32	4 23	A.M.
Sat.	18	4 57	7 15	3 49	9 57	P.M.	11 12	P.M.	4 55	0 11
Sun.	19	4 57	7 14	4 54	10 46	0 57	A.M.	1 21	5 25	1 09
Mon.	20	4 58	7 14	sets	11 41	1 44	1 01	3 08	5 53	2 25
Tues.	21	4 59	7 13	8 36	A.M.	2 29	0 52	2 51	6 21	3 31
Wed.	22	5 00	7 13	9 19	0 36	2 50	1 42	3 29	6 58	4 41
Thur.	23	5 00	7 12	9 58	1 36	3 26	2 34	4 01	7 37	5 48
Frid.	24	5 01	7 11	10 35	2 44	4 08	3 31	4 38	8 20	7 03
Sat.	25	5 02	7 10	11 11	small	large	small	large	small	large
Sun.	26	5 03	7 09	11 47	5 11	5 53	5 45	6 18	9 52	9 37
Mon.	27	5 04	7 08	morn	6 27	6 37	7 00	7 13	10 23	11 06
Tues.	28	5 04	7 08	0 23	7 41	7 15	8 17	8 04	10 30	P.M.
Wed.	29	5 05	7 07	1 03	8 57	7 57	9 34	9 01	10 51	2 22
Thur.	30	5 06	7 06	1 45	10 07	8 41	10 40	9 47	11 16	3 43
Frid.	31	5 07	7 05	2 31	11 06	9 12	11 39	10 40	A.M.	4 46

JULY, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	s.			
1	N.23 5 18	10.6	3 35.5	0.47			
2	23 0 52	11.6	3 46.7	0.46			
3	22 56 2	12.6	3 57.7	0.45			
4	22 50 48	13.6	4 8.3	0.44			
5	22 45 10	14.6	4 18.6	0.42			
6	22 39 8	15.6	4 28.6	0.41			
7	22 32 43	16.5	4 38.2	0.39			
8	22 25 54	17.5	4 47.5	0 38			
9	22 18 43	18.5	4 56.3	0.36			
10	22 11 8	19.4	5 4.8	0.34			
11	22 3 10	20.4	5 12.8	0.33			
12	21 54 49	21.3	5 20.4	0.31			
13	21 46 6	22.3	5 27.6	0.29			
14	21 37 0	23.2	5 34.3	0.27			
15	21 27 33	24.1	5 40.6	0.25			
16	21 17 43	25.0	5 46.3	0.23			
17	21 7 32	25.9	5 51.6	0 21			
18	20 56 59	26.8	5 56.3	0.19			
19	20 46 5	27.7	6 0.5	0.16			
20	20 34 50	28.6	6 4.1	0.14			
21	20 23 14	29.4	6 7.2	0.12			
22	20 11 18	30.3	6 9.7	0.09			
23	19 59 1	31.1	6 11.7	0.07			
24	19 46 25	31.9	6 13.0	0.04			
25	19 33 29	32 7	6 13.7	0.02			
26	19 20 13	33.6	6 13.9	0.01			
27	19 6 38	34.3	6 13.4	0.03			
28	18 52 44	35.1	6 12.3	0.06			
29	18 38 32	35.9	6 10.5	0.08			
30	18 24 1	36.7	6 8.2	0.11			
31	18 9 12	37.4	6 5.2	0.14			

AUGUST, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Small.	Large.	Small.	Large.	Small.	Large.
					A.M.	P.M.	P.M.	P.M.	A.M.	P.M.
Sat.	1	5 07	7 04	3 19	11 59	9 59	0 22	11 15	0 10	4 38
Sun.	2	5 08	7 03	4 10	P.M.	10 41	1 04	11 55	1 07	4 59
Mon.	3	5 09	7 02	rises	1 17	11 29	1 44	A.M.	2 00	5 14
Tues.	4	5 10	7 01	8 02	1 41	A.M.	2 14	0 39	3 15	5 47
Wed.	5	5 11	7 00	8 35	2 07	0 07	2 43	1 17	4 06	6 08
Thur.	6	5 12	6 59	9 05	2 31	0 53	3 07	1 58	5 02	6 28
Frid.	7	5 13	6 58	9 35	2 56	1 41	3 31	2 42	5 59	6 49
Sat.	8	5 14	6 57	10 05	3 25	2 32	3 56	3 26	6 56	7 22
Sun.	9	5 15	6 56	10 38	large	small	large	small	large	small
Mon.	10	5 16	6 55	11 14	4 53	4 29	5 20	5 04	9 34	8 12
Tues.	11	5 17	6 53	11 53	5 35	5 43	6 09	6 09	11 27	8 27
Wed.	12	5 17	6 52	morn	6 18	7 01	7 06	7 24	P.M.	9 04
Thur.	13	5 18	6 51	0 38	7 09	8 18	8 07	8 41	2 25	9 47
Frid.	14	5 19	6 50	1 32	8 00	9 35	9 12	10 02	3 13	11 01
Sat.	15	5 19	6 49	2 32	8 52	10 54	10 08	11 13	3 49	A.M.
Sun.	16	5 20	6 48	3 39	9 44	11 52	10 58	P.M.	4 24	0 13
Mon.	17	5 21	6 47	4 51	10 36	P.M.	11 48	1 09	4 53	1 24
Tues.	18	5 22	6 45	sets	11 32	1 24	A.M.	1 55	5 15	2 31
Wed.	19	5 23	6 44	7 51	A.M.	2 06	0 40	2 27	5 46	3 35
Thur	20	5 24	6 43	8 30	0 27	2 17	1 31	2 58	6 16	4 36
Frid.	21	5 25	6 41	9 07	1 24	2 48	2 23	3 30	6 50	5 42
Sat.	22	5 26	6 40	9 45	small	large	small	large	small	large
Sun.	23	5 27	6 39	10 22	3 47	3 57	4 23	4 36	7 40	8 25
Mon.	24	5 28	6 37	11 02	5 07	4 41	5 33	5 20	7 58	9 54
Tues.	25	5 29	6 36	11 43	6 29	5 29	6 51	6 18	8 32	11 50
Wed.	26	5 30	6 35	morn	7 45	6 19	8 07	7 14	9 13	P.M.
Thur.	27	5 31	6 33	0 28	8 57	7 03	9 21	8 22	10 19	2 43
Frid.	28	5 32	6 31	1 16	10 07	8 07	10 24	9 17	11 23	3 23
Sat.	29	5 33	6 29	2 06	10 57	8 59	11 20	10 11	A.M.	3 51
Sun.	30	5 34	6 28	2 59	11 40	9 52	P.M.	11 00	0 23	3 37
Mon.	31	5 35	6 27	3 54	P.M.	10 37	0 39	11 42	1 21	3 53

AUGUST, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to be *added* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	s.			
1	N.17 54 6	38.1	6 1.6	0.16			
2	17 38 42	38.9	5 57.4	0.19			
3	17 23 0	39.6	5 52.6	0.21			
4	17 7 2	40.3	5 47.2	0.24			
5	16 50 47	41.0	5 41.2	0.26			
6	16 34 16	41.6	5 34.7	0.29			
7	16 17 28	42.3	5 27.5	0.31			
8	16 0 25	42.9	5 19.8	0.33			
9	15 43 7	43.6	5 11.5	0.36			
10	15 25 33	44.2	5 2.6	0.38			
11	15 7 44	44.8	4 53.2	0.40			
12	14 49 41	45.4	4 43.3	0.42			
13	14 31 23	46.0	4 32.8	0.45			
14	14 12 52	46.6	4 21.8	0.47			
15	13 54 7	47.2	4 10.3	0.49			
16	13 35 8	47.7	3 58.3	0.51			
17	13 15 57	48.2	3 45.8	0.53			
18	12 56 33	48.8	3 32.7	0.55			
19	12 36 57	49.3	3 19.2	0.57			
20	12 17 8	49.8	3 5.2	0.59			
21	11 57 8	50.2	2 50.7	0.61			
22	11 36 57	50 7	2 35.7	0.63			
23	11 16 34	51.2	2 20.3	0.65			
24	10 56 1	51.6	2 4.5	0.67			
25	10 35 18	52.0	1 48.2	0.69			
26	10 14 24	52.4	1 31.5	0 70			
27	9 53 21	52.8	1 14.4	0.72			
28	9 32 9	53.2	0 56.9	0.74			
29	9 10 47	53.6	0 39.0	0.75			
30	8 49 17	53.9	0 20.8	0.76			
31	8 27 38	54.3	0 2.3	0.78			

SEPTEMBER, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon sets.	HIGH WATER		HIGH WATER		HIGH WATER	
					Small.	Large.	Small.	Large.	Small.	Large.
					P.M.	P.M.	P.M.		A.M.	P.M.
Tues.	1	5 35	6 25	6 36	0 38	11 24	1 11	A.M.	2 18	4 20
Wed.	2	5 36	6 24	7 09	0 53	A.M.	1 32	0 26	3 23	4 49
Thur.	3	5 37	6 23	7 38	1 15	0 03	1 57	1 07	4 15	5 05
Frid.	4	5 37	6 21	8 09	1 35	0 51	2 18	1 52	5 02	5 28
Sat.	5	5 38	6 20	8 41	large	small	large	small	large	small
Sun.	6	5 39	6 19	9 14	2 28	2 22	3 07	3 15	7 10	5 48
Mon.	7	5 39	6 17	9 52	2 59	3 18	3 40	3 56	8 54	5 54
Tues.	8	5 40	6 15	10 33	3 43	4 25	4 23	4 55	10 20	6 20
Wed.	9	5 41	6 13	11 22	4 35	5 43	5 17	5 58	11 43	7 05
Thur.	10	5 42	6 12	morn	5 26	7 01	6 27	7 12	P.M.	8 30
Frid.	11	5 43	6 11	0 18	6 33	8 20	7 38	8 28	1 35	9 59
Sat.	12	5 43	6 09	1 20	7 42	9 33	8 50	9 47	2 22	11 22
Sun.	13	5 44	6 07	2 17	8 45	10 40	9 55	11 01	2 59	A.M.
Mon.	14	5 45	6 06	3 38	9 43	11 33	10 50	P.M.	3 29	0 37
Tues.	15	5 46	6 04	4 50	10 37	P.M.	11 42	0 49	4 01	1 49
Wed.	16	5 47	6 02	sets	11 34	0 51	A.M.	1 29	4 23	2 51
Thur.	17	5 48	6 00	7 01	A.M.	1 04	0 37	1 44	4 49	3 49
Frid.	18	5 49	5 59	7 38	small	large	small	large	small	large
Sat.	19	5 50	5 58	8 16	1 34	1 44	2 27	2 40	5 14	6 10
Sun.	20	5 51	5 56	8 56	2 35	2 09	3 19	3 06	5 18	7 28
Mon.	21	5 52	5 55	9 38	3 45	2 45	4 16	3 43	5 46	9 10
Tues.	22	5 53	5 53	10 23	5 05	3 39	5 20	4 27	6 31	10 38
Wed.	23	5 54	5 52	11 11	6 23	4 29	6 33	5 34	7 51	P.M.
Thur.	24	5 55	5 51	morn	7 39	5 39	7 43	6 36	9 10	0 55
Frid.	25	5 55	5 49	0 01	8 42	6 44	8 52	7 43	10 25	1 38
Sat.	26	5 56	5 47	0 53	9 37	7 49	9 55	8 50	11 32	2 17
Sun.	27	5 57	5 45	1 46	10 23	8 49	10 48	9 51	A.M.	2 46
Mon.	28	5 58	5 44	2 41	11 00	9 46	11 30	10 45	0 36	2 38
Tues.	29	5 59	5 43	3 36	11 27	10 37	P.M.	11 37	1 38	3 04
Wed.	30	5 59	5 41	4 32	11 50	11 26	0 29	A.M.	2 23	3 13

SEPTEMBER, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* from Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	N. 8 5 51	54.6	0 16.6	0.79			
2	7 43 57	54.9	0 35.7	0 80			
3	7 21 54	55.3	0 55.1	0.81			
4	6 59 45	55.6	1 14.7	0.82			
5	6 37 28	55.8	1 34.6	0.83			
6	6 15 6	56.1	1 54.7	0.84			
7	5 52 36	56.3	2 15.0	0.85			
8	5 30 1	56.6	2 35.4	0.85			
9	5 7 20	56.8	2 56.0	0.86			
10	4 44 34	57.0	3 16.7	0.86			
11	4 21 44	57.2	3 37.5	0.87			
12	3 58 48	57.4	3 58.4	0.87			
13	3 35 48	57.6	4 19.3	0.87			
14	3 12 44	57.8	4 40.3	0.88			
15	2 49 36	57.9	5 1.4	0.88			
16	2 26 25	58.0	5 22.4	0.88			
17	2 3 11	58.1	5 43.5	0.88			
18	1 39 55	58.2	6 4.6	0.88			
19	1 16 36	58.3	6 25.6	0.87			
20	0 53 15	58.4	6 46.6	0.87			
21	0 29 53	58.5	7 7.5	0.87			
22	N. 0 6 30	58.5	7 28.4	0.87			
23	S. 0 16 54	58.5	7 49.1	0.86			
24	0 40 19	58.5	8 9.7	0.86			
25	1 3 44	58.5	8 30.2	0.85			
26	1 27 8	58.5	8 50.6	0.84			
27	1 50 32	58.5	9 10.7	0.83			
28	2 13 55	58.4	9 30.6	0.83			
29	2 37 17	58.4	9 50.3	0.82			
30	3 0 37	58.3	10 9.8	0.80			

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OCTOBER, 1868.

Day of Week.	Day of Month.	*San Francisco.* Sun rises.	Sun sets.	Moon sets.	HIGH WATER Small.	Large.	*Astoria.* HIGH WATER Small.	Large.	*Port Townsend.* HIGH WATER Small.	Large.
					P.M.		P.M.	A.M.	A.M.	P.M.
Thur.	1	6 00	5 40	6 11	0 10	A.M.	0 52	0 24	3 15	3 41
Frid.	2	6 01	5 38	6 42	large	small	large	small	large	small
Sat.	3	6 02	5 36	7 16	1 02	0 28	1 47	1 28	4 59	4 37
Sun.	4	6 03	5 34	7 52	1 23	1 20	2 13	2 16	6 06	4 44
Mon.	5	6 04	5 32	8 32	1 44	2 13	2 36	3 02	7 38	4 38
Tues.	6	6 05	5 31	9 19	2 15	3 10	3 07	3 51	8 57	4 57
Wed.	7	6 06	5 29	10 11	3 06	4 15	3 51	4 42	10 16	5 38
Thur.	8	6 07	5 28	11 09	4 12	5 32	4 55	5 46	11 10	6 58
Frid.	9	6 08	5 26	morn	5 09	7 06	6 05	6 56	P.M.	8 32
Sat.	10	6 09	5 25	0 13	6 20	8 09	7 21	8 14	1 02	10 02
Sun.	11	6 10	5 24	1 20	7 31	9 18	8 36	9 32	1 48	11 26
Mon.	12	6 11	5 22	2 29	8 36	10 19	9 42	10 43	2 23	A.M.
Tues.	13	6 12	5 21	3 39	9 35	11 10	10 38	11 41	2 55	0 43
Wed.	14	6 13	5 20	4 49	10 30	11 49	11 32	P.M.	3 23	1 45
Thur.	15	6 14	5 19	5 58	11 24	P.M.	A.M.	0 59	3 45	2 49
Frid.	16	6 15	5 18	sets	small	large	small	large	small	large
Sat.	17	6 16	5 16	6 46	0 28	0 48	1 24	1 37	4 00	5 02
Sun.	18	6 17	5 14	7 29	1 25	0 59	2 14	2 01	3 57	6 14
Mon.	19	6 18	5 13	8 13	2 27	1 27	3 08	2 35	4 16	7 49
Tues.	20	6 19	5 12	9 00	3 31	2 05	4 00	3 07	4 54	9 08
Wed.	21	6 20	5 10	9 51	4 41	2 47	4 57	3 58	6 06	10 24
Thur.	22	6 21	5 09	10 43	6 00	4 00	6 00	4 53	7 28	11 10
Frid.	23	6 22	5 08	11 38	7 06	5 08	7 07	5 58	8 50	11 56
Sat.	24	6 23	5 06	morn	8 02	6 14	8 12	7 07	10 06	P.M.
Sun.	25	6 24	5 05	0 32	8 53	7 19	9 10	8 13	11 18	1 20
Mon.	26	6 25	5 04	1 27	9 39	8 25	10 04	9 19	A.M.	1 50
Tues.	27	6 26	5 02	2 23	10 15	9 25	10 48	10 23	0 17	1 43
Wed.	28	6 27	5 01	3 19	10 44	10 20	11 21	11 16	1 15	2 05
Thur.	29	6 28	5 00	4 16	11 08	11 12	11 48	A.M.	2 10	2 36
Frid.	30	6 29	4 59	5 14	large	small	large	small	large	small
Sat.	31	6 30	4 58	rises	11 57	A.M.	P.M.	0 40	3 57	2 35

OCTOBER, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* f'm Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	S.			
1	S. 3 23 55	58.2	10 29.0	0.79			
2	3 47 11	58.1	10 47.9	0.78			
3	4 10 24	58.0	11 6.4	0.77			
4	4 33 35	57.9	11 24.6	0.75			
5	4 56 42	57.7	11 42.5	0.74			
6	5 19 45	57.6	11 59.9	0.72			
7	5 42 45	57.4	12 16.9	0.70			
8	6 5 40	57.2	12 33.5	0.68			
9	6 28 30	57.0	12 49.7	0.66			
10	6 51 16	56.8	13 5.3	0.64			
11	7 13 56	56.6	13 20.5	0.62			
12	7 36 30	56.3	13 35.1	0.60			
13	7 58 58	56.0	13 49.2	0.58			
14	8 21 19	55.7	14 2.8	0.55			
15	8 43 34	55.4	14 15.8	0.53			
16	9 5 41	55.1	14 28.3	0.51			
17	9 27 40	54.8	14 40.1	0.48			
18	9 49 31	54.5	14 51.4	0.46			
19	10 11 13	54.1	15 2.0	0.43			
20	10 32 47	53.7	15 12.0	0.40			
21	10 54 11	53.3	15 21.4	0.38			
22	11 15 25	52.9	15 30.1	0.35			
23	11 36 29	52.4	15 38.2	0.32			
24	11 57 22	52.0	15 45.6	0.29			
25	12 18 4	51.5	15 52.3	0.26			
26	12 38 35	51.0	15 58.2	0.23			
27	12 58 54	50.5	16 3.5	0.20			
28	13 19 1	50.0	16 8.0	0.17			
29	13 38 54	49.5	16 11.8	0.14			
30	13 58 35	48.9	16 14.8	0.11			
31	14 18 3	48.4	16 17.0	0.07			

NOVEMBER, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon rises.	HIGH WATER		HIGH WATER		HIGH WATER	
					Large.	Small.	Large.	Small.	Large.	Small.
					P.M.	A.M.	P.M.	A.M.	A.M.	P.M.
Sun.	1	6 30	4 58	6 22	0 03	0 47	1 00	1 32	5 53	2 53
Mon.	2	6 32	4 56	7 11	0 26	1 29	1 29	2 15	7 03	3 03
Tues.	3	6 33	4 55	8 07	0 55	2 26	1 59	3 04	8 06	3 28
Wed.	4	6 34	4 54	9 07	1 32	3 21	2 41	3 54	8 46	4 34
Thur.	5	6 35	4 53	10 04	2 32	4 26	3 30	4 42	9 30	5 54
Frid.	6	6 36	4 52	11 11	3 46	5 32	4 37	5 39	10 20	7 20
Sat.	7	6 37	4 51	morn	5 03	6 44	5 52	6 48	11 17	8 55
Sun.	8	6 38	4 50	0 18	6 15	7 51	7 09	7 59	P.M.	10 26
Mon.	9	6 39	4 49	1 26	7 30	8 49	8 27	9 08	0 55	11 45
Tues.	10	6 40	4 48	2 33	8 39	9 44	9 37	10 14	1 31	A.M.
Wed.	11	6 41	4 47	3 39	9 37	10 29	10 38	11 04	2 00	0 57
Thur.	12	6 42	4 46	4 47	small	large	small	large	small	large
Frid.	13	6 44	4 46	5 51	11 39	11 27	A.M.	P.M.	2 19	3 22
Sat.	14	6 45	4 45	sets	A.M.	11 39	0 28	0 15	2 08	4 33
Sun.	15	6 46	4 44	6 03	0 39	11 49	1 24	0 51	2 19	6 00
Mon.	16	6 47	4 43	6 50	1 38	P.M.	2 15	1 22	2 44	7 11
Tues.	17	6 48	4 42	7 30	2 34	0 40	3 06	2 07	3 43	8 14
Wed.	18	6 49	4 41	8 32	3 31	1 31	3 50	2 43	4 52	8 47
Thur.	19	6 50	4 41	9 25	4 24	2 26	4 36	3 27	6 05	9 20
Frid.	20	6 51	4 40	10 21	5 22	3 34	5 27	4 22	7 24	9 57
Sat.	21	6 52	4 40	11 16	6 19	4 45	6 25	5 28	8 45	10 38
Sun.	22	6 53	4 40	morn	7 09	5 55	7 19	6 34	9 57	11 17
Mon.	23	6 54	4 40	0 12	7 52	7 02	8 13	7 48	11 07	11 59
Tues.	24	6 55	4 39	1 07	8 32	8 08	8 57	8 52	A.M.	P.M.
Wed.	25	6 56	4 39	2 03	9 09	9 13	9 44	10 03	0 13	0 39
Thur.	26	6 57	4 39	3 00	large	small	large	small	large	small
Frid.	27	6 58	4 38	3 59	10 15	11 05	10 59	11 48	2 14	0 52
Sat.	28	6 59	4 38	4 59	10 39	A.M.	11 29	A.M.	3 24	0 24
Sun.	29	7 00	4 37	rises	10 58	0 05	11 55	0 44	4 53	0 53
Mon.	30	7 01	4 37	5 57	11 11	0 58	P.M.	1 33	6 21	1 43

NOVEMBER, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* from Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
	° ′ ″	″	M. S.	s.			
1	S. 14 37 17	47.8	16 18.4	0.04			
2	14 56 16	47.2	16 19.0	0.01			
3	15 15 1	46.6	16 18.8	0.03			
4	15 33 31	45.9	16 17.7	0.06			
5	15 51 46	45.3	16 15.9	0.10			
6	16 9 45	44.6	16 13.1	0.13			
7	16 27 28	43.9	16 9.5	0.17			
8	16 44 54	43.2	16 5.1	0.20			
9	17 2 3	42.5	15 59.8	0.24			
10	17 18 55	41.8	15 53.6	0.28			
11	17 35 29	41.0	15 46.5	0.31			
12	17 51 45	40.3	15 38.6	0.35			
13	18 7 42	39.5	15 29.8	0.38			
14	18 23 21	38.7	15 20.2	0.42			
15	18 38 40	37.9	15 9.8	0.45			
16	18 53 39	37.0	14 58.4	0.49			
17	19 8 17	36.2	14 46.3	0.52			
18	19 22 36	35.3	14 33.3	0.56			
19	19 36 33	34.4	14 19.6	0.59			
20	19 50 9	33.5	14 5.0	0.62			
21	20 3 23	32.6	13 49.6	0.66			
22	20 16 15	31.7	13 33.5	0.69			
23	20 28 44	30.7	13 16.6	0.72			
24	20 40 51	29.8	12 59.0	0.75			
25	20 52 34	28.8	12 40.6	0.78			
26	21 3 54	27.8	12 21.5	0.81			
27	21 14 51	26.8	12 1.6	0.84			
28	21 25 23	25.8	11 41.1	0.87			
29	21 35 30	24.8	11 19.8	0.90			
30	21 45 13	23.7	10 58.0	0.93			

DECEMBER, 1868.

Day of Week.	Day of Month.	*San Francisco.*					*Astoria.*		*Port Townsend.*	
		Sun rises.	Sun sets.	Moon rises.	HIGH WATER		HIGH WATER		HIGH WATER	
					Large.	Small.	Large.	Small.	Large.	Small.
					A.M.	A.M.	P.M.	A.M.	A.M.	P.M.
Tues.	1	7 02	4 37	6 53	11 42	1 36	0 59	2 13	6 52	2 40
Wed.	2	7 03	4 37	7 56	P.M.	2 36	1 39	3 00	7 21	3 45
Thur.	3	7 04	4 37	9 02	1 17	3 25	2 25	3 48	7 57	4 57
Frid.	4	7 05	4 37	10 10	2 23	4 15	3 19	4 36	8 40	6 18
Sat.	5	7 06	4 36	11 18	3 44	5 11	4 29	5 26	9 26	7 46
Sun.	6	7 07	4 36	morn	5 02	6 18	5 43	6 28	10 22	9 12
Mon.	7	7 08	4 36	0 24	6 17	7 16	7 03	7 30	11 12	10 38
Tues.	8	7 09	4 36	1 31	7 32	8 07	8 21	8 30	11 57	11 59
Wed.	9	7 10	4 36	2 46	small	large	small	large	small	large
Thur.	10	7 10	4 36	3 39	9 54	9 32	10 42	10 12	P.M.	A.M.
Frid.	11	7 11	4 37	4 43	10 58	10 04	11 41	10 55	0 27	2 46
Sat.	12	7 12	4 37	5 45	11 55	10 32	A.M.	11 28	0 40	4 19
Sun.	13	7 12	4 37	6 43	A.M.	10 45	0 32	11 39	1 00	5 32
Mon.	14	7 13	4 37	sets	0 46	10 52	1 22	P.M.	1 52	6 30
Tues.	15	7 13	4 38	6 21	1 44	11 44	2 08	1 01	2 53	6 56
Wed.	16	7 14	4 38	7 15	2 29	P.M.	2 53	1 44	3 52	7 21
Thur.	17	7 15	4 38	8 10	3 08	1 20	3 32	2 27	4 57	7 44
Frid.	18	7 16	4 39	9 05	3 47	2 13	4 09	3 12	6 08	8 11
Sat.	19	7 17	4 39	10 01	4 29	3 15	4 46	4 01	7 15	8 40
Sun.	20	7 18	4 39	10 56	5 15	4 25	5 29	5 04	8 26	9 17
Mon.	21	7 18	4 40	11 52	5 59	5 35	6 13	6 08	9 42	9 52
Tues.	22	7 18	4 40	morn	6 40	6 44	6 59	7 18	10 48	10 32
Wed.	23	7 19	4 41	0 47	large	small	large	small	large	small
Thur.	24	7 19	4 41	1 44	8 02	8 52	8 36	9 25	A.M.	10 44
Frid.	25	7 19	4 42	2 41	8 37	10 03	9 22	10 37	1 24	10 24
Sat.	26	7 19	4 43	3 42	9 08	11 08	10 02	11 37	3 01	11 01
Sun.	27	7 20	4 43	4 44	9 37	A.M.	10 39	A.M.	4 16	11 38
Mon.	28	7 20	4 44	5 47	10 08	0 03	11 14	0 34	5 21	P.M.
Tues.	29	7 20	4 45	rises	10 38	1 02	11 56	1 15	5 52	2 16
Wed.	30	7 20	4 46	6 45	11 25	1 38	P.M.	2 05	6 01	3 01
Thur.	31	7 21	4 47	7 56	P.M.	2 23	1 29	2 51	6 32	4 10

DECEMBER, 1868.

Day of Month.	The Sun's *apparent* Declination.	Diff. for One Hour.	Equation of Time, to *subtract* from / *add* to Apparent Time.	Diff. for One Hour.	Ship's Latitude.	Ship's Longitude.	Error of Chronometer.
			M. S.	S.			
1	S. 21° 54′ 31″	22.7	10 35.4	0.95			
2	22 3 23	21.6	10 12.2	0.98			
3	22 11 50	20.6	9 48.4	1.00			
4	22 19 52	19.5	9 24.0	1.03			
5	22 27 27	18.4	8 59.0	1.05			
6	22 34 36	17.3	8 33.5	1.07			
7	22 41 19	16 2	8 7.4	1.10			
8	22 47 34	15.1	7 40.9	1.12			
9	22 53 23	14.0	7 13.8	1.13			
10	22 58 45	12.8	6 46.4	1.15			
11	23 3 40	11.7	6 18.5	1.17			
12	23 8 7	10.6	5 50.2	1.18			
13	23 12 7	9.4	5 21.6	1.20			
14	23 15 38	8.2	4 52.7	1.21			
15	23 18 42	7.1	4 23.5	1.22			
16	23 21 18	5.9	3 54.1	1.23			
17	23 23 26	4.7	3 24.5	1.23			
18	23 25 6	3.6	2 54.8	1.24			
19	23 26 17	2.4	2 24.9	1.24			
20	23 27 0	1.2	1 55.0	1.25			
21	23 27 15	0.0	1 25.0	1.25			
22	23 27 2	1.2	0 55.0	1.25			
23	23 26 20	2.3	0 25.0	1.25			
24	23 25 10	3.5	0 4.9	1.24			
25	23 23 31	4.7	0 34.7	1.24			
26	23 21 25	5.9	1 4.4	1.23			
27	23 18 50	7.0	1 33.9	1.23			
28	23 15 47	8.2	2 3.3	1.22			
29	23 12 16	9.4	2 32.4	1.21			
30	23 8 17	10.5	3 1.3	1.20			
31	23 3 51	11.7	3 29.9	1.19			

Tidal Constants.

To obtain the time of High Water for **Monterey, Santa Cruz, South Farallon, Mare Island, Benicia, Ravenswood,** and **Bodega,** find the time for **SAN FRANCISCO:** then for

		H.	M.
Monterey	Subtract	1	44
Santa Cruz	Subtract	1	48
South Farallon	Subtract	1	29
Mare Island (San Francisco Bay)	Add	1	34
Benicia (San Francisco Bay)	Add	2	4
Ravenswood (San Francisco Bay)	Add	0	30
Bodega	Subtract	0	49

For **Humboldt Bay, Port Orford, Koos Bay, Nee-ah Harbor,** and **Cape Disappointment,** find the time for **ASTORIA:** then for

		H.	M.
Humboldt Bay	Subtract		40
Port Orford	Subtract	1	16
Koos Bay (north bend)	Add		28
Nee-ah Harbor	Subtract		9
Cape Disappointment	Subtract		40

For **Steilacoom** and **Semi-ah-moo Bay,** find the time for **PORT TOWNSEND:** then for

		H.	M.
Steilacoom	Add		57
Semi-ah-moo Bay	Add	1	1

Phases of the Moon, 1868.

(Civil Time at Greenwich.)

JANUARY.

	d	h	m	
First Quarter.	3	4	3	morn
Full Moon ...	9	10	53	even
Last Quarter .	16	5	4	even
New Moon...	24	7	18	even

FEBRUARY.

First Quarter.	1	6	16	even
Full Moon ...	8	9	35	morn
Last Quarter .	15	9	17	morn
New Moon...	23	2	20	even

MARCH.

First Quarter.	2	4	49	morn
Full Moon ...	8	8	22	even
Last Quarter .	16	3	28	morn
New Moon...	24	6	59	morn
First Quarter.	31	0	26	even

APRIL.

Full Moon ...	7	7	17	morn
Last Quarter .	14	10	34	even
New Moon...	22	8	20	even
First Quarter.	29	6	18	even

MAY.

Full Moon ..	6	6	37	even
Last Quarter .	14	5	15	even
New Moon...	22	6	36	morn
First Quarter.	28	11	42	even

JUNE.

Full Moon ...	5	6	55	morn
Last Quarter .	13	10	14	morn
New Moon...	20	2	45	even
First Quarter.	27	5	51	morn

JULY.

	d	h	m	
Full Moon ...	4	8	39	even
Last Quarter .	13	0	40	morn
New Moon...	19	9	56	even
First Quarter.	26	1	52	even

AUGUST.

Full Moon ...	3	11	52	morn
Last Quarter .	11	0	28	even
New Moon...	18	5	11	morn
First Quarter.	25	0	47	morn

SEPTEMBER.

Full Moon ...	2	3	57	morn
Last Quarter .	9	10	4	even
New Moon...	16	1	19	even
First Quarter.	23	3	22	even

OCTOBER.

Full Moon ...	1	7	58	even
Last Quarter .	9	6	13	morn
New Moon...	15	11	1	even
First Quarter.	23	9	42	morn
Full Moon ...	31	11	5	morn

NOVEMBER.

Last Quarter .	7	1	46	even
New Moon...	14	10	55	morn
First Quarter.	22	6	46	morn
Full Moon ...	30	1	0	morn

DECEMBER.

Last Quarter .	6	9	34	even
New Moon...	14	1	33	morn
First Quarter.	22	4	28	morn
Full Moon ...	29	1	48	even

GEOGRAPHICAL POSITIONS

Of Important Headlands, Light-Houses, etc., on the Western Coast.

Name of Station.	Locality.	Latitude North.	Longitude West.	Varied East.
		° ′ ″	° ′ ″	° ′
Los Coronados	The largest islet	32 23 46	117 13 21	....
Point Loma Light-House, 3 F W 25	W side of entrance to the bay, 450 feet high	32 40 15	117 13 30	....
Cortez Shoal	Two-and-a-half-fathom spot	32 26 00	119 05 00	....
San Pedro Bay	Edge of bluff at landing	33 43 20	118 16 03	13 30
Santa Barbara Light-House, 4 F W 12	Two miles SW of landing, 180 feet	34 23 35	119 42 05	....
Point Conception Light-House, 1 Rv W Fl ½ M 23	Point Conception, 250 feet. Fog bell	34 26 47	120 20 33	....
Point Sur	51 miles SE ½ S from Point Año Nuevo	36 19 00	121 52 00	....
Point Pinos Light-House, 3 F W 13	At NW point of the trees, 91 feet	36 37 52	121 55 00	14 58
Point Año Nuevo	40 miles SE by S from San Francisco bar	37 07 00	122 19 00	....
Point San Pedro	13 miles S by E ½ E from Boneta light	37 35 45	122 30 34	....
South Farallon L. H., 1 Rv W Pr Fl every M 26	23½ miles SW by W ¼ W off cnt. to S F bay, 360 ft	37 41 49	122 59 05	....
Point Lobos	South head of entrance to San Francisco bay	37 46 50	122 29 39	....
Point Boneta Light-House, 2 F W 24, bell	North head of entrance to San Francisco bay, 306 ft	37 49 04	122 30 50	....
Fort Point Light-House, 5 F W 12½, bell	South side of entrance to San Francisco bay, 53 ft	37 48 31	122 27 38	....
Alcatraz Island Light-House, 3 F W 14, bell	In the harbor of San Francisco, 166 ft	37 49 27	122 24 19	....
Point Reyes	On the western head of the point	37 59 39	123 00 13	....
Mendocino Bay	On the bluff near the landing	39 18 06	123 47 26	....
Cape Mendocino	Extremity of the cape	40 25 00	124 22 00	....
Humboldt Light-House, 4 F W 12	On the N point one mile from entrance, 53 ft	40 46 04	124 12 10	17 04
Trinidad	Town of Trinidad, Trinidad bay	41 03 20	124 08 08	....
Crescent City Light-Housc, 4 F W Var by Fl 14	On the extreme W part of the point, 80 ft	41 44 34	124 11 22	....
Cape Gregory	NW part of the cape off Koos bay	43 20 37	124 22 15	....
Cape Arago Light-House, 4 F W Var by Fl 15	On small island at western extremity of cape, 75 ft	43 20 38	124 22 20	....
Cape Foulweather	Southern part of the capc	44 45 00	124 04 00	....
Cape Lookout	Sharp point farthest west	45 20 00	124 00 00	....
Tillamook Head	SE by S ⅔ S, 19 miles from Disappointment light	45 58 00	123 59 00	....
Point Adams	S point, ent. to Columbia River, half mile inside	46 12 30	123 56 56	....
Cape Disappointment Light-House, 1 F W 22½	Near the highest part of the cape. Fog bell	46 16 35	124 02 13	20 45
Cape Shoalwater Light-House, 4 F W Var by Fl 14	N point of entrance to Shoalwater bay, 87 ft	46 44 11	124 02 24	....
Point Grenville	Point of the bluff at the anchorage	47 20 00	124 14 00	....
Flattery Rocks	Northwestern rocky islet	48 12 00	124 43 00	....
Tatoosh Island Light-House, 1 F W 20	Off Cape Flattery, Strait of Juan de Fuca	48 23 15	124 43 48	21 30
Ediz Hook Light-House, 5 F 10	On False Dungeness, extremity of spit	48 08 56	123 25 30	....
New Dungeness Light-House, 3 F W 16½, bell	On the end of the Sand Point, Strait of Juan de Fuca	48 10 59	123 06 07	....
Smith's Island L. H., 4 Rv W Var Fl every ½ m	SW point of the island	48 19 01	122 50 01	....
Admiralty Head Light-House, 4 F W 17½	E side of entrance to Admiralty Inlet, 119 ft	48 09 22	122 40 08	....
Race Rocks Light-House, 2 W Fl every 10 secs	Southernmost p'nt of Vancouver, St. J. de Fuca, 118 ft	48 17 30	123 32 15	....
Fisgard Island Light-House, 4 F 15	W side ent. Esquimault bar, Strait Juan de Fuca, 70 ft	48 25 38	123 27 10	....

NOTE.—The numerals first given after each Light-House indicate the order of the lights: F signifies fixed; Fl, flashing; Var, varied; Rv, revolving; Pr, prolonged; W, white; Rd, red; M, minutes; and the concluding numerals denote the distance at which the light may be seen, under ordinary states of the atmosphere, from a height of twenty feet above the sea.

Noonday Rock.

From the U. S. Coast Survey Directory of the Pacific Coast.

This danger lies nearly on the prolongation of the line from the South Farallon, through the North Farallones. It is of very limited extent, and is, doubtless, a sharp isolated point of a small ledge, having from twenty to thirty fathoms immediately around it. It is plainly visible when directly over it, and has three and a half fathoms of water upon it at mean low water. In very heavy weather and low water the sea breaks upon it, but this indication seldom exists, and must not be depended upon for ascertaining its position.

From it the following bearings (*magnetic*) will show its relation to other well marked and determined points:

Punta de los Reyes, western head N. 13° 25′ E., distant 13 8-10 miles.
North Farallon, S. 79° 30′ E., distant 3 1-10 miles.
South Farallon Light-House, S. 69° 45′ E., distant 9 7-10 miles.
Point Boneta Light-House, N. 71° 32′ E., distant 30 3-10 miles.
Geographical position: latitude, 37° 47½′ N.; longitude, 123° 09′ W.

In the "Directory" it is advised that vessels approaching the Golden Gate at night, or in thick weather, should keep to the southward of the South Farallon light. With Punta de los Reyes and the Farallones in sight, vessels bound in, and running between them, should keep the western head of Los Reyes open on a N.N.E. course, coming nothing to the eastward until the North and South Farallones are in range, then bear away for the Golden Gate. In that position the rock will bear S.E., distant two and one-third miles. Coming from the northwestward at night, vessels should not bring the South Farallon light to bear anything east of S.E. by E., which will clear the rock by two miles and the North Farallones by one mile.

Rocks in the Pacific Ocean.

Reported by Capt. Bursley, of ship "Minnehaha," in latitude 26° 00′ south, longitude 106° 28′ west, standing 4 feet awash. Reported by Capt. Jorres, of brig "Emily," in latitude 29° 34′ south, longitude 87° 31′ west; is 120 feet long, and 15 feet out of water: he went on it and took a good observation; his chronometer was correct, as proved by subsequent observations.

There is a rock between the South Farallon and Middle Rock (off San Francisco Harbor), supposed to have between three and four fathoms on it; has been seen by pilots when it breaks.

Bearsley Shoal, reported by Capt. Bearsley, of ship "Vitula," and located

eighty miles S.S.W. (by compass) from the Farallones, has on it seven fathoms. This is since laid down approximately, on Imray's chart of 1866.

Capt. Redfield, of the whaling brig "Susan Abigail," reports some very dangerous rocks awash, lying about 800 miles nearly due west from this port, right in the track of vessels bound in from the Sandwich Islands. Their position, as taken by him (with excellent observations), was in Lat. 37° 35′ north, Long. 137° 30′ west. The larger rock he judges to be about 50 feet broad and 150 feet long, and to have about ten feet of water; S.S.E. from which, by compass, distance about a quarter of a mile, he saw a discoloration of water, it having the appearance of there being another and a smaller rock. They are in the same longitude, but eight miles further south than Reed's Rocks, as laid down on the charts.

The United States ship "Falmouth" discovered a rock with from three to five fathoms of water, in Lat. 37° 22′ north, Long. 137° 25′ west; this may be the same one reported by Capt. Redfield.

This danger is laid down on Imray's chart of North Pacific, 1866, as a shoal with three to five fathoms.

Capt. Grindle, of the ship "Elizabeth Kimball," reports as follows: "On my voyage from Hong Kong to San Francisco, at 9 o'clock, A.M., May 6th, 1863, I passed over a shoal (not laid down on the charts), in about five fathoms water, seeing the bottom distinctly. This shoal bears W.S.W. seven miles from rocks laid down on the chart as doubtful, in Lat. 31° 40′ north, Long. 139° 35′ east. This position on the chart is wrong. In sight of these islets I had several good observations, and at noon was within two miles of them, with a correct meridian altitude, and I made them in Lat. 31° 52′ north, Long. 139° 53′ east. The peaks of these rocks are from twenty to forty feet high, and the cluster about one mile long from S.W. to N.E. I found a current of two miles an hour setting N.E., and it being nearly calm, was with difficulty prevented from drifting on them. Strong ripplings will be found on approaching these rocks from the S.W., within eight or ten miles of their position."

Reef in the Java Sea to the North of the Thousand Islands.—On the nineteenth of August, 1864, the ship "Mandarin" ran on and struck the rocks with less than twelve feet of water. The reef is about three miles in extent, running E.S.E. by W.N.W.; it is not laid down on any but the latest Dutch charts of 1863, and on those merely as a rock, whereas it is of great extent. The following bearings were taken: North Island, bearing N.N.W.; a small island to the eastward of West Islands, due west; the North Watcher, just in sight, due north.

Unit Rock in the Canal de Haro.—When eight and a half miles within the south entrance of the Strait the width decreases to three and a

half miles, having Darcy Island on the west; off its N.E. face lies a small islet, and off the S.E. face lie very large fields of kelp, stretching far off to the southeast; in 1863, in one of these fields, was discovered a sharp pointed rock, called Unit Rock, lying N. 72° E. (magnetic) from the S.E. part of the island, and distant three quarters of a mile; the sharp apex of this rock was about three feet above water at the very lowest tides.

Strait of Juan de Fuca.—A patch of kelp is found one mile south of the southeastern point of Bellevue or San Juan Island, and eight and a half miles N.W. by W. one quarter W. from Smith's Island, with three fathoms marked on it, but it is reported that H. B. Co.'s steamer "Otter" found only six feet.

Bearing W. half S. from Smith's Island, and eight miles distant, is another field of kelp, nearly a mile in extent, having five fathoms throughout it.

Wreck of Ship Flying Dragon.—On the eleventh of February, 1863, Aug. F. Rodgers, Assistant U. S. Coast Survey, reported the following bearings of the wreck of ship "Flying Dragon," in San Francisco Bay, and directions for avoiding it.

Arch, or Bird Rock, East (magnetic), distant two hundred and seventy yards.

Shag Rock.—N. by E. quarter N. (magnetic), distant six hundred and sixty yards. In sweeping for the "Flying Dragon," one of her spars was caught and held to with six fathoms of line out. It is not improbable that her topmast heads come nearer the surface, and deep ships had better give the locality a good berth in working across the channel. There are twenty fathoms of water immediately around the wreck, with fourteen to seventeen fathoms half a ship's length distant on all sides.

The intersection of the following ranges will show the position of the wreck:

South side of Bird, or Arch Rock, in one with south beach of Yerba Buena Island, crossed by Saucelito Point Beach in one with Table Mountain Peak.

Keeping above ranges well open or closed clears the wreck.

Table of Distances on West Coast of North America.

UP THE COAST.

From San Francisco—

To	Miles.	To	Miles.
Ballenas Bay	14	Tillamook Head	533
Point Reyes	30	Cape Disappointment	552
Point Tomales	46	Shoalwater Bay	578
Bodega Head	50	Gray's Harbor	590
Fort Ross	65	Point Grenville	614
Point Arena	101	Cape Flattery	682
Mendocino City	122	Port Angeles	738
Shelter Cove	166	Port Townsend	770
Cape Mendocino	194	Seattle	808
Humboldt Bay	218	Steilacoom	838
Trinidad	235	Olympia	863
Crescent City	277	Victoria	748
Rogue's River	319	San Juan Island	755
Port Orford	338	Bellingham Bay	790
Cape Blanco	345	New Westminster	820
Cape Gregory	376	Barclay Sound	724
Umpqua River	399	Nootka Sound	784
Cape Perpetua	434	Cordova Bay	1178
Cape Foulweather	460	Coronation Island	1273
Cape Lookout	496	Sitka	1333
False Tillamook	520		

DOWN THE COAST.

From San Francisco—

To	Miles.	To	Miles.
Pillar Point	26	Point Vincent	365
Point Año Nuevo	50	Point Loma	443
Santa Cruz	72	Port San Quentin	555
Point Pinos	90	Cerros Island	700
Point Sur	110	Magdalena Bay	983
Point Gorda	142	Cape St. Lucas	1143
Piedras Blancas	160	Cape Corrientes	1413
San Simeon	165	Mazatlan	1336
Point San Luis	200	Guaymas	1488
Point Sal	215	Manzanillo	1518
Point Arguello	235	Acapulco	1820
Point Conception	253	Realejo	2590
Santa Barbara	293	Nicaragua	2678
Anacapa Island	312	Coiba Island	3018
Santa Catalina	350	Panama	3260

Sailing Directions

For the Western Coast of the United States, from Monterey to the Columbia River.

[Extract from Report of Lieut. McArthur, Assistant U. S. Coast Survey.]

Previous to giving sailing directions for this part of our coast, I propose to notice the character of the winds, at different seasons, with the effect upon the sea and currents.

From March to October, the prevailing wind along the coast, and for many miles to the westward, is fresh from the northwest, being freshest from 10 A.M. to 2 P.M., and not unfrequently falling light during the night. During this season of the year, the northwest wind blows with almost the regularity of a trade-wind. During the months of August and September, fogs prevail to a great extent, and impede and endanger navigation materially.

During the part of the year above mentioned, there are no heavy gales of wind, and little or no rain. These winds cause a current of about half a knot per hour along the coast, setting to the southward. From October to March, the wind is variable, both with regard to velocity and direction. During this season heavy gales occur from the southeast, south, and southwest, generally accompanied by protracted rain, and causing a very heavy sea and swell along the coast. The current during this season sets generally to the northward, varying in velocity, with the strength of the wind.

These facts being known, it is now to be considered how directions should be given which would be most useful to Navigation.

Sailing vessels bound to the north from Monterey, or any more northern port during the summer season, should stand well off shore, not too close-hauled, until about two hundred miles from the land, when they will be beyond the influence of the southerly current, and in a situation to take advantage of a slant of wind, which frequently occurs from the west-northwest. They would do well not to approach the land, unless favored by the wind so as to enable them to lay their course, or nearly so, until up with the latitude of the destined port.

Steamers should follow the coast from point to point, as nearly as possible, always keeping within fifteen miles of the land. They will by this means shorten the distance, and frequently avoid the strong northwest winds, and often they will find it quite calm close in with the shore, while there is a strong wind to seaward. Vessels bound to the northward in the winter season, should keep as close along the land as practicable, and take every advantage of all southerly winds to make latitude. They should always endeavor to make the land at least twenty or thirty miles to the southward of the destined harbor.

Navigators bound to the southward, should keep the coast in sight, and take advantage of either tack upon which the most latitude may be made, always making the land to the northward of the port in summer, and to the southward in the winter season. * * *

In view of the importance of disseminating reliable information in regard to the navigation of this coast, we are led to extract from the *Pacific Coast Directory*, reported by George Davidson, Ass't U. S. Coast Survey.

The Winds.—It has been advised to work close along shore to northern ports during the summer northwest winds, and take the chances of land breezes to make latitude, but the attempt will double the length of any voyage. Baffling light airs and calms frequently exist along the coast, while vessels several hundred miles off have strong northwest winds. Moreover, along the coast we know that the current frequently sets two miles per hour from the northward, except very close under the shores. In our experience, we never yet have met a wind off the land north of San Francisco, and very rarely indeed, south of it, except in the region of the Santa Barbara Channel. As a general rule, it may be safely stated that the summer winds follow the line of the coast, nearly, and gradually draw towards and over the land. In winter, with wind from the southward, this is not so marked.

From April to October, inclusive, the prevailing wind is from the northwest, changing to west in valleys opening upon the coast, but in no case so strongly as through the Golden Gate.

During the summer, the wind sets in strong about 10 A.M., increasing until nearly sunset, when it begins to die away. During its height it almost regularly brings in a dense fog, which, working its way over the peninsula, meets that already advanced through the Golden Gate, and envelopes San Francisco and the bay by sunset. As a rule, the breeze does not dispel the fog. If a fog exists outside, the wind is sure to bring it in, but the heated earth dissipates it for a time.

From November to March the wind is frequently from the southeast, blowing heavily, working round to the southwest, with a large and broken swell from the southwest, weather thick, rainy, and squally; the wind not unfrequently ending at northwest, with an ugly cross-sea. During heavy southeasters, the sea breaks upon the San Francisco bar, clean across the entrance, presenting a fearful sight. The sound can be heard at the anchorage in front of the city.

During some winters a hard "Norther" will spring up and blow steadily and strongly from one to five days, with a clear blue sky and cold bracing weather. Winds rarely blow from points between north, round by the east to southeast.

The farther north we advance, the heavier blow the gales in the winter.

Sailing Directions

For approaching and entering San Francisco Bay.

In approaching the coast, every opportunity should be seized for determining the vessel's position, as fogs and thick weather prevail near the land. Vessels coming from the *southward*, make the coast about Point Año Nuevo (lat. 37° 07′ N.), and follow it a distance of four or five miles up to the bar. Steamers keep close under the land for fear of losing it in foggy weather. Coming from the *westward*, they first sight the South Farallon Island (lat. 37° 42′ N.), having the light-house upon it, and keep open either side of it, but it is preferable to go to the southward, especially in thick weather, or at night. * * *

From the South Farallon Light-house, the Point Boneta light bears N.E. by E., twenty-three and two-thirds miles.

Coming from the *Northwestward*, they make Punta de los Reyes, five hundred and ninety-seven feet high, in lat. 38° 00′ N., long. 123° 00′ W., and pass within two or three miles of it, fifteen fathoms being found within a quarter of a mile from it, but vessels are apt to lose the wind by getting too close under it. From the western extremity of this point, the Point Boneta Light-house bears E. $\frac{3}{4}$ S., distant twenty-five and three-fourths miles, the line passing over the tail of Duxbury Reef, at a distance of seventeen and one-quarter miles from Los Reyes. * * *

The range from Alcatraz Island to Fort Point, gives a course N.E. $\frac{3}{4}$ E., for vessels entering the Golden Gate. It is designated by Belcher, the "Fair-way line," and he calls the Island and Fort "Fair-way marks." But with a heavy swell on the bar this range should be used merely as a line of reference, because on the bar it passes over a small five-fathom spot, while half a fathom more can be obtained for a distance of two miles, both north and south of it.

In clear weather and with a favorable wind, a vessel can cross the bar in not less than five fathoms, from the line having the north end of Alcatraz Island just open by Point Boneta (N.E. by E. $\frac{3}{4}$ E.), round to the shore south of Point Lobos (N. by W. $\frac{1}{3}$ W.). Northward of the former line, the "*four-fathom bank*" (having three and three-quarters fathoms on it) commences one mile west of Boneta, and stretches over three miles, with a breadth of one mile. * * * Between the *eastern* extremity of the "four-fathom bank," and the shore, the distance is seven-eighths of a mile, and within this space can be found the deepest water for entering the harbor, but it would be dangerous for a sailing vessel to attempt it with a flood tide and light winds. When it is breaking on the bank, only a heavy swell is found through this eight-and-one-half-fathom channel, and sail-boats have passed in safety when they dared not try the bar.

During clear, moderate weather, any vessel can cross the bar, within the limits we have mentioned, without running until she has got on the "Fairway line," whereby she might lose her slant of wind. Should the wind fail, or be light, and the current adverse, anchor outside the bar in fifteen fathoms—mud and fine sand; or, after crossing the bar, in six to ten fathoms—fine, gray sand, with red specks in some places. Run in mid-channel between the Heads; avoid too close proximity to the northern shore, not only in entering but leaving; the high, bold bluffs causing calms and baffling airs, even with a southeaster blowing out.

Between Fort Point and the opposite shore, take special care not to approach Fort Point too close, because the currents set around it irregularly, and with great rapidity, and the bottom is uneven and rocky. A depth of sixty-nine fathoms is given in the center of the channel.

In the Golden Gate we have measured an ebb current running about six miles an hour.

As a general rule, the winds increase within the Heads, drawing in very strongly abreast Fort Point. When off this point, steer for Alcatraz Light-house, until the north point of Telegraph Hill bears E. by S., then steer to give it a berth of a quarter of a mile, running through among the shipping.

In making the port at night, cross the bar with Fort Point light, on with Alcatraz Island light, or better, the latter open a little to the northward. But this practice frequently involves much delay and annoyance, when the wind will not permit a vessel to attain this position without a tack. With Boneta light bearing from N. by W. to N.E. by E., a vessel may boldly run on within those limits, and unless there be a heavy swell, safely cross the "four-fathom bank."

Give Boneta a berth of a mile, and when within the Heads, and Boneta abeam, gradually open Alcatraz light north of Fort Point, until abeam of the latter; then run for Alcatraz until the lights of the shipping show the vessel's position. Hauling up for them, anchor off the North Beach in ten fathoms, or off the N.E. front of the city, in ten fathoms, soft mud. * * *

In coming up the coast in thick, foggy weather, sailing vessels should not run into less than fifty fathoms, because the water around the South Farallon and off Fort Point, San Pedro, and Punta de los Reyes, is very bold. It is believed, however, that a thirty-fathom bank exists at a considerable distance to the westward of the last.

Southwest of the line passing through the Farallones and Noonday Rock, the one-hundred fathom curve is only four miles distant, and the fifty-fathom curve only two miles, with very irregular bottom. If the Farallones be made, a course can be easily laid for the bar. It would not be advisable, however, to run into less than ten fathoms, soft mud. * * *

The Bearings which have been above given are *magnetic*.

Fog Signals in and about San Francisco Harbor.

Fog Bell at Point Boneta.—The bell, with machinery, is in a frame building, open in front, and placed on a bluff in advance of the light-house tower, at an elevation of two hundred and seventy feet above the level of the sea. The bell weighs one thousand five hundred pounds, and during foggy weather is struck six blows, at intervals of sixteen seconds each, followed by a pause of forty-four seconds.

Fog Bell at Fort Point.—The frame-work supporting the bell is on the eastern side of the light-house, forty and a half feet above the surface of the ground. The bell weighs one thousand and ninety-two pounds, and during foggy weather is struck by machinery, at intervals of ten seconds, followed by a pause of thirty-four seconds.

Fog Bell on Alcatraz Island.—The frame-work supporting the bell is on the southeastern extremity of the island, close to the water's edge, and is elevated about thirty feet above the water. The bell weighs one thousand and ninety-two pounds, and during foggy or thick weather, is struck by machinery four blows, at intervals of eight seconds, followed by a pause of fifteen seconds.

[NOTES, ED.—The *bell boat* referred to in the "Pacific Coast Directory" has been removed from the bar.

The firing of the *fog gun* at Point Boneta has been discontinued.]

A Fog Trumpet (Daboll's patent) has been placed on Point Lobos by the Pacific Mail Steamship Company. It is sounded by steam during foggy weather, and may be heard seaward (dependant on the direction and strength of the wind) within a range of from six to ten miles.

A Fog Whistle was placed on the southeast part of the South Farallon in 1859; it is six inches in diameter; placed over a natural hole in the roof of a subterranean passage, connected with and open to the ocean. It is blown by a rush of air through the passage caused by the action of the sea. Its loudness depends upon the height of the tide and waves. It is sometimes heard a distance of five or six miles, but frequently not at all, and is, from this fact, generally considered unreliable.

Extract of the Pilot Laws,

For San Francisco, Mare Island, and Benicia.

SECTION 10. It shall be the duty of every Pilot in charge of a vessel arriving in the harbor of San Francisco, to have the vessel safely moored, in such position as the Master of the vessel or the Harbor Master may direct.

SEC. 14. Every Pilot boarding a vessel shall, at the request of the Master, exhibit his license, and if he willfully refuse to do so, he shall forfeit the same.

SEC. 15. If any Pilot shall become habitually intemperate, or shall be intoxicated while in charge of any vessel as Pilot, he shall forfeit his license.

SEC. 16. If any Pilot shall negligently, ignorantly, or willfully run a vessel on shore, (or otherwise render her liable to injury) he shall forfeit his license, and shall be incapable ever afterwards of being licensed as a Pilot under this Act.

SEC. 18. Any person not holding a license as Pilot, approved by said Examiners, who shall pilot any vessel into or out of the harbor of San Francisco, to Mare Island or Benicia, or from Mare Island or Benicia to the harbor of San Francisco, except such as are exempt by virtue of this Act, shall be deemed guilty of misdemeanor, and on conviction in any Court of competent jurisdiction, shall be punished by a fine not exceeding five hundred dollars, or imprisonment not exceeding ninety days.

SEC. 20. Every Pilot carried to sea against his will, when a boat is in attendance to receive him, shall be entitled to receive the sum of eight dollars per day while absent, which sum may be recovered from the Master or owners of the vessel so taking him away; *provided,* the amount herein allowed to be recovered shall in no case exceed one thousand dollars.

SEC. 21. The pilotage inside of the Heads to the anchorage opposite San Francisco, and about the harbor of San Francisco, to or from Mare Island or Benicia, shall be at such rates as shall be agreed upon between the parties, not to exceed the sum of seven dollars per foot draft.

SEC. 22. All vessels, their tackle, apparel, and furniture, and the Master and owners thereof, shall be jointly and severally liable for pilotage fees, to be recovered in any Court of competent jurisdiction.

SEC. 23. When two or more Pilots shall offer their services to a vessel outside of a line drawn from Point Boneta to the outward Wolf Rock, inward bound, the Pilot first offering his services, or one connected with the same boat, shall have preference; and if the Master of any vessel shall refuse to observe such rule of preference, and to take the Pilot entitled to be preferred on board; the vessel, her appurtenances, the Master, and owner thereof, shall be jointly and severally liable, to the Pilot entitled to such preference, for

one-half the amount of pilotage he would have been entitled to claim had his services been accepted.

Sec. 24. The following shall be the rates of pilotage into or out of the harbor of San Francisco:

All vessels under five hundred tons, six dollars per foot draft; all vessels over five hundred tons, seven dollars per foot draft, and four cents per ton for each and every ton of registered measurement; all vessels engaged in the Whaling trade, one dollar per foot draft; when a vessel is spoken, and the services of a Pilot declined, one-half of the rate shall be paid; all Government vessels, ten dollars per foot draft; all vessels coasting between ports of this State and any port or ports of Oregon and Washington Territory, registered in this State, and all vessels coasting between ports of this State, shall be exempt from all pilot charges, unless a Pilot be actually employed.

Sec. 25. When any vessel is in tow of a steam tug outward bound, or between the Bay of San Francisco and Benicia, and Mare Island, said vessel shall not be liable for pilotage, except a Pilot be actually employed.

Approved April 4th, 1864.

[Note, Ed.—There are belonging to San Francisco four first-class Pilot Boats, and fifteen Licensed Pilots. Two boats are always cruising outside, frequently as far as fifteen miles from the land, in clear weather. During a fog they cruise nearer the bar, being in that neighborhood most likely to fall in with vessels.]

Regulations

Of the Harbor and Port of San Francisco.

Article 1.—No vessel shall be moored in the harbor of San Francisco nearer than five hundred yards from a line with the ends of the wharves; the Harbor Master will, on application, designate a proper berth, and give the necessary directions for mooring, according to the season of the year.

Art. 2. All Masters and Pilots are notified not to anchor vessels within five hundred yards of a line with the ends of the wharves from North Point to the Third Street Wharf, which space must be kept clear for the accommodation of vessels approaching or leaving the Wharves.

Art. 3. All vessels lying at single anchor must have a good and sufficient light shown in some part of the rigging, at least fifteen feet above deck, during the night. Any violation of this Article will render them liable for damages in the event of collision.

Art. 4. Vessels lying at the wharves or in the slips shall top the lower yards by the lifts nearest the wharf, rig in all movable fore and aft spars, spritsail yards, and davits, and have one anchor clear for dropping; *provided*, vessels headed toward the shore end of the dock shall not be required to rig in the jib-boom unless specially ordered.

ART. 5. Vessels lying on the flats between Market and Folsom Street Wharves, shall top their lower yards by the starboard lifts, and otherwise conform to Article 4th.

ART. 6. Vessels lying at the end of the wharves shall haul each way, to accommodate vessels going into or out of the docks.

ART. 7. All vessels not discharging or receiving cargoes, shall make room for those needing immediate accommodation; vessels wishing to discharge, to have the preference of berth to those loading.

ART. 8. All vessels shall have on board ship-keepers, or persons competent to take care of them; and if any vessels shall be required to remove, and no person be on board, the Harbor Master will cause the same to be removed at the expense of the Master, Owners, or Consignee, and the vessel will be liable for all damages.

ART. 9. No vessel shall be moored or made fast in such place or manner as shall in any wise obstruct or interfere with steamboats or other vessels hauling in or out of the docks or slips.

ART. 10. No ballast or other heavy matter shall be thrown overboard from any vessel in the harbor or slips, and when ballast is being taken on board, a tarpaulin must be placed between the vessel and wharf, or lighter, to prevent the same from falling into the water.

ART. 11. No pitch, tar, or other combustibles shall be heated on board of any vessel at any of the wharves, piers, slips or basins of this city, but all such works shall be done on floating stages or boats; vessels with gunpowder on board must anchor below Vallejo Street Wharf, and outside the channel designated in Art. 2d, until the same is discharged.

ART. 12. Disobedience to the orders of the Harbor Master, in the discharge of his duties, will subject the offender to a fine not exceeding five hundred dollars, to be paid into the City and County Treasury, according to law.

ART. 13. The harbor dues are payable at the Harbor Master's office within forty-eight hours after the arrival of the vessel. Coastwise vessels and Bay craft pay two cents per ton quarterly, in advance, from the first day of January, each year; other vessels pay four cents per ton each voyage: if not paid in the specified time, double the amount of costs may be collected.

ART. 14. The Harbor Master is empowered to determine cases of collision by consent of all parties interested; and where damages do not exceed three hundred dollars, the decision is final.

ART. 15. No hulk, storeship, dismantled or condemned craft shall be moored in the immediate vicinity of the wharves, or where such position is likely to interfere with legitimate shipping.

ART. 16. No vessel shall anchor in any dock or slip between Vallejo and Howard Streets.

Approved March, 1866.

An Act to establish Police Regulations

For the Harbor of the City and County of San Francisco, and to authorize and empower the Board of Supervisors to regulate the same.

SECTION 1. No person shall board or attempt to board any vessel arriving in the harbor of the City and County of San Francisco, before said vessel has been made fast to the wharf, without obtaining leave from the Master or person having charge of said vessel, or permission in writing from the owner or owners, or the agent thereof; or having boarded such vessel shall refuse or neglect to leave the same upon the request of the Master, or other person in charge thereof, under the penalty prescribed in the next succeeding section of this Act.

SEC. 2. Any person violating Section 1, of this Act, shall be deemed guilty of misdemeanor, and upon conviction thereof before the Police Judge's Court of said city and county, shall be punished for each offense by a fine not exceeding one hundred dollars, or imprisonment in the County Jail of the City and County of San Francisco, for a term not exceeding fifty days, or both, in the discretion of the Judge of the said Police Judge's Court, which Court shall have jurisdiction in such cases.

SEC. 3. The provision of the last two foregoing sections shall not apply to any Pilot, or public officer visiting a vessel in discharge of his duty.

SEC. 4. No person shall entice or persuade, nor attempt to entice or persuade, any member of the crew of any vessel arriving in said harbor, or of any vessel in said harbor, to leave or desert said vessel, before the expiration of his term of service in such vessel. Any person guilty of so doing shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be subject to the penalty prescribed in Section 2, of this Act.

SEC. 5. No person shall knowingly or willfully persuade or aid any person who shall have shipped on any vessel for a voyage from said port, and received any advance wages therefor to desert or willfully neglect to proceed on such voyage. Any person guilty of so doing shall be deemed guilty of a misdemeanor, and upon conviction thereof before the Police Judge's Court of said city and county, shall be punished for each offense by a fine not exceeding one hundred dollars, or imprisonment in the County Jail of the City and County of San Francisco, for a term not exceeding fifty days, or both, in the discretion of the Judge of the said Police Judge's Court, which Court shall have jurisdiction in such cases.

SEC. 6. Any person offending against any provision of this Act may be arrested with or without warrant, as provided in other cases of misdemeanor, by any officer qualified to serve criminal process in the said City and County of San Francisco; *provided*, the person so arrested shall be forthwith brought before said Police Judge's Court, or admitted to bail, as

in other cases of misdemeanor committed in said City and County of San Francisco.

SEC. 7. The word "harbor," as used in this Act, shall be held to mean and include all the waters in the Bay of San Francisco, within the limits of the said City and County of San Francisco; and the word "vessel," as used in this Act, shall be held to mean and include all vessels propelled by steam or sails, plying or bound on a voyage between the said port of San Francisco and any other port in this State, or in any other State of the United States, or in any foreign country.

SEC. 8. The Board of Supervisors of said City and County of San Francisco shall cause this Act to be printed in cheap pamphlet form, and it shall be the duty of each and every Branch Pilot of the port of San Francisco to obtain, from the Clerk of the Board of Supervisors of said city and county, a reasonable supply of said pamphlets, and to deliver one copy of the same to the Master, or person in charge of each and every vessel boarded by him as a Pilot, whether the said Pilot is employed to bring such vessel into said port or not.

SEC. 9. Any Branch Pilot refusing or neglecting to perform the requirements set forth in the last preceding section, shall be deemed guilty of misdemeanor, and shall, upon conviction thereof before the Police Judge's Court of said city and county, be fined in the sum of ten dollars, or be imprisoned in the County Jail for the term of twenty-five days, or both, in the discretion of the Judge of said Police Judge's Court, which said Court is hereby given jurisdiction in such cases.

Approved April 4th, 1864.

Passenger Act of the State of California.

The Passenger Act of the State of California requires *all masters or commanders of vessels, arriving from ports outside of the State of California,* to make report to the Commissioner of Immigration within twenty-four hours of arrival. The report is to contain the names of all persons or passengers on board who may be naturalized citizens of the United States; also, their age, nativity, occupation, place, and date of naturalization. The report must also contain the names, ages, nationality, and occupation of all persons or passengers on board, not citizens of the United States. Masters or commanders of vessels are to require all persons claiming to be naturalized citizens to make oath to or affirm the same, giving the time and place where said naturalization took place.

All persons or passengers not citizens are to be bonded in the sum of $500 each, by the master or consignees of vessels, within three days' time of their landing; said bonds to run for two years from date, or they can be commuted for on the payment of five dollars per head. Special bonds are re-

quired for all "lunatic, deaf, dumb, blind, crippled, or infirm persons, whose circumstances make it liable they will become a burden on the State." The penalty for non-report is $200, and $200 per alien passengers not reported. The penalty for not bonding or commuting is $1,000 per passenger, and in case of lunatics, etc., not reported, $2,000. Ships, captains, and consignees are responsible for penalties incurred.

Act of Congress to prevent Collisions at Sea.

[Approved, April, 1864.]

BE IT ENACTED, *by the Senate and House of Representatives of the United States of America, in Congress assembled:*

That from and after September 1, 1864, the following Rules and Regulations for preventing collisions on the water be adopted in the Navy and Mercantile Marine of the United States; *provided,* that the exhibition of any light on board of a vessel of war of the United States may be suspended whenever, in the opinion of the Secretary of the Navy, the Commander-in-Chief of a squadron, or the Commander of a vessel acting singly, the special character of the service may require it.

PRELIMINARY.

ARTICLE 1. In the following rules every steamship which is under sail and not under steam, is to be considered a sailing ship; and every steamship which is under steam, whether under sail or not, is to be considered a ship under steam.

RULES CONCERNING LIGHTS.

Lights.

ART. 2. The lights mentioned in the following articles, and *no* others, shall be carried in all weathers between sunset and sunrise.

Lights for Steamships.

ART. 3. All steam vessels when under way, shall carry

(*a.*) At the foremast head a bright *white* light, so fixed as to show an uniform and unbroken light over an arc of the horizon of twenty points of the compass; so fixed as to throw the light ten points each side of the ship, viz: from right ahead to two points abaft the beam on either side, and of such a character as to be visible on a dark night, with a clear atmosphere, at a distance of, at least, *five* miles.

(*b.*) On the *starboard* side a *green* light, so constructed as to throw an uniform and unbroken light over an arc of the horizon of ten points of the compass; so fixed as to throw the light from right ahead to two points abaft the beam on the *starboard* side, and of such a character as to be visible

on a dark night with a clear atmosphere, at a distance of at least *two* miles.

(*c.*) On the *port* side a *red* light, so constructed as to show an uniform unbroken light over an arc of the horizon of ten points of the compass; so fixed as to throw the light from right ahead to two points abaft the beam on the *port* side, and of such a character as to be visible on a dark night with a clear atmosphere, at a distance of at least *two* miles.

(*d.*) The said green and red side lights shall be fitted with inboard screens projecting at least three feet forward from the light, so as to prevent these lights from being seen across the bow.

Lights for Steam Tugs.

ART. 4. Steamships when towing other ships shall carry *two* bright *white* mast-head lights vertically, in addition to their side lights, to distinguish them from other steamships. Each of these mast-head lights shall be of the same construction and character as the mast-head lights which other steamships are required to carry.

Lights for Sailing Ships.

ART. 5. Sailing ships, under way or being towed, shall carry the same lights as steamships under way, with the exception of the *white* mast-head lights, which they shall never carry.

Exceptional Lights for Small Sailing Vessels.

ART. 6. Whenever, as in the case of small vessels during bad weather, the green and red lights cannot be fixed, these lights shall be kept on deck, on their respective sides of the vessel, ready for instant exhibition, and shall, on the approach of or to other vessels, be exhibited on their respective sides in sufficient time to prevent collision, in such manner as to make them most visible, and so that the *green* light shall not be seen on the *port* side nor the *red* light on the *starboard* side.

To make the use of these portable lights more certain and easy, they shall each be painted outside with the color of the light they respectively contain, and shall be provided with suitable screens.

Lights for Ships at Anchor.

ART. 7. Ships, whether steamships or sailing ships, when at anchor in roadsteads or fairways, shall, between sunset and sunrise, exhibit where it can best be seen, but at a height not exceeding twenty feet above the hull, a *white* light in a globular lantern of eight inches in diameter, and so constructed as to show a clear, uniform, and unbroken light visible all around the horizon, and at a distance of at least *one* mile.

Lights for Pilot Vessels.

ART. 8. Sailing pilot vessels shall not carry the lights required for other sailing vessels, but shall carry a *white* light at the mast-head visible

all around the horizon, and shall also exhibit a *flare-up* light every fifteen minutes.

Lights for Fishing Vessels and Boats.

ART. 9. Open fishing boats and other open boats shall not be required to carry side lights required for other vessels, but shall, if they do not carry such lights, carry a lantern having a *green* slide on the one side, and a *red* slide on the other side, and on the approach of or to other vessels, such lantern shall be exhibited in sufficient time to prevent collision, so that the *green* light shall not be seen on the *port* side nor the *red* light on the *starboard* side. Fishing vessels and open boats when at anchor, or attached to their nets and stationary, shall exhibit a bright *white* light. Fishing vessels and open boats shall, however, not be prevented from using a *flare up* in addition, if considered expedient.

RULES GOVERNING FOG SIGNALS.

Fog Signals.

ART. 10. Whenever there is a fog, whether by day or night, the fog signals described below shall be carried and used, and shall be sounded at every five minutes, viz:

(*a.*) *Steamships* under way shall use a *steam whistle* placed before the funnel not less than eight feet from the deck.

(*b.*) *Sailing ships* under way shall use a *fog horn.*

(*c.*) *Steamships* and *sailing* ships when not under way shall use a *bell.*

STEERING AND SAILING RULES.

Two Sailing Ships Meeting.

ART. 11. If two sailing ships are meeting end on, or nearly end on, so as to involve risk of collision, the helms of both shall be put to *port*, so that each shall pass on the *port* side of the other.

Two Sailing Ships Crossing.

ART. 12. When two sailing ships are crossing so as to involve risk of collision, then, if they have the wind on different sides, the ship with the wind on the *port* side shall keep out of the way of the ship with the wind on the *starboard* side except in the case in which the ship with the wind on the *port* side is *close-hauled*, and the other ship *free*, in which case the latter ship shall keep out of the way. But if they have the wind on the *same side*, or if one of them has the wind *aft*, the ship which is to *windward* shall keep out of the way of the ship which is to *leeward.*

Two Ships under Steam, Meeting.

ART. 13. If two ships under steam are meeting end on, or nearly end

on, so as to involve risk of collision, the helms of both shall be put to *port*, so that each may pass on the *port* side of the other.

Two Ships under Steam, Crossing.

ART. 14. If two ships, under steam, are crossing, so as to involve risk of collision, the ship which has the other on her *starboard* side, shall keep out of the way of the other.

Sailing Ship and Ship under Steam.

ART. 15. If two ships, one of which is a sailing ship and the other a steam ship, are proceeding in such directions as to involve risk of collision, the steam ship shall keep out of the way of the sailing ship.

Ship under Steam, to slacken Speed.

ART. 16. Every *steamship*, when approaching another ship, so as to involve risk of collision, shall slacken her speed, or if necessary, stop and reverse; and every steamship shall, when in a fog, go at a moderate speed.

Vessels Overtaking other Vessels.

ART 17. Every vessel overtaking any other vessel, shall keep out of the way of the said last mentioned vessel.

Construction of Articles 12, 14, 15 *and* 17.

ART. 18. Where, by the preceding rules, one of two ships is to keep out of the way, the other shall keep her course, subject to the qualifications contained in the following article:

Proviso to save Special Cases.

ART. 19. In obeying and construing these rules due regard must be had to all dangers of navigation, and due regard must also be had to any special circumstances, which may exist in any particular case, rendering a departure from the above rules necessary, in order to avoid immediate danger.

No Ship under any Circumstances to neglect Proper Precautions.

ART. 20. Nothing in these rules shall exonerate any ship, or the owner or master, or crew thereof, from the consequence of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any precaution which may be required by the ordinary practice of seamen, or by the special circumstances of the case.

Hurricanes.

[Compiled.]

Hurricanes are caused by a portion of the atmosphere becoming violently heated, and thereby acquiring a circular motion about a center or focus, and around this Focus the wind rushes with great violence. The Meteor has also a progressive motion, at a rate varying from twelve to thirty miles per hour. The diameters of these Meteors vary from one hundred to three hundred miles. The wind blows with the greatest fury near the center, and there also the shifts of wind are most rapid; toward the circumference the wind has less force, and the time between the changes is of greater length.

The places most subject to Hurricanes are the northern limits of the N.E. trade-wind to the eastward of the meridian of the West India Islands in the N. Atlantic Ocean, and the southern limit of the S.E. trade to the eastward of the meridian of the Island of Mauritius in the S. Atlantic. Hurricanes also occur in the Bay of Bengal and its vicinity, at the change of the Monsoons in May and October.

Hurricanes in the North Atlantic Ocean commence on the northern limits of the N.E. trade-wind, in August and September, and traveling to the westward, visit the West India Islands, and thence pursue a N.E. course parallel with the Gulf Stream, along the coast of the United States of North America. The diameter of this meteor varies from one hundred to two hundred miles, and its progress is at the rate of about seventeen miles an hour. But the most distinctive feature of this Hurricane is, that it blows from *Right* to *Left*, around the Focus, or center, it being a calm space.

The Typhoons of the China Sea seem to differ in nothing but name from the Hurricane of the well-frequented seas of the Western Atlantic. They rotate in the same manner (from right to left). They appear to originate in the same latitude, and to travel in the same direction—at first northwestward, till they arrive at the northern limit of the trade-wind, and then turning northeastward, parallel with the coast of China. These storms occur during both Monsoons, but are more violent during the months of June and July.

The S.W. Monsoon commences about the latter end of April, and continues until October, with much rain and squally weather. Typhoons occur most frequently during this Monsoon. The N.E. Monsoon blows the balance of the year, with generally fine, dry weather. The most terrific Hurricanes frequently occur about the *change* of the Monsoons.

Hurricanes in the South Atlantic commence near the southern limits of the S.E. trades, to the eastward of the Island of Mauritius, and pursue a course to the westward. These are generally looked for during the months of February or March. The distinctive features of these Hurricanes are

that they rotate about a Focus from *Left* to *Right*, contrary to the action of similar winds in the Northern Hemisphere. Every ship navigating seas where Hurricanes are likely to occur, should be provided with a *good* barometer and sympiesometer, and strict attention should be paid to their movements. When the barometer falls to 29°.50, the weather threatening, and the clouds of a bluish, gloomy appearance, the ship is on the verge of the storm circle, and the Focus may be 150 miles distant. As the Focus is approached, the barometer falls to 29°.20 inches, one hundred miles distant, 28°.40 at about fifty miles, and to 28° at thirty miles. Near the Focus it is sometimes so low as 27°.

There is now less danger in encountering these tempests, owing to the skill and researches of Redfield, Reed, Piddington, and others, who have collected a vast number of facts bearing upon and elucidating the general laws by which these storms are governed.

Rules to avoid Hurricanes.

The vortex of a Typhoon or Hurricane may be avoided, and the ship placed beyond its reach by the following rule:

Place your back to the wind, then if the vessel be in *North* latitude, the vortex of the Hurricane will be on your *left hand;* but, if in *South* latitude, it will be on your *right:* in both cases, at right angles from the direction in which you are looking.

We append the following table of directions, from "Thom's Navigator:"

IN NORTH LATITUDE.

Hurricane Wind.	Bearing of Focus.	When the Path is to the W.N.W.	When the Path is to the N.E.
Wind E ..	Focus bears S	Heave to on port tack..	Steer 50 miles NW—heave to on port tack.
" NE.	" SE	" "	Heave to on port tack.
" N ..	" E	Run 50 miles S and heave to	" "
" NW	" NE	Heave to on port tack..	" "
" W .	" N	" "	" "
" SW	" NW	" "	" "
" S ..	" W	" "	Get to the Eastward, if possible, and heave to.
" SE.	" SW	" "	Run 50 miles NW and heave to.

IN SOUTH LATITUDE.

Hurricane Wind.	Bearing of Focus.	When the Path is to the W.S.W.	When the Path is to the S.E.
Wind W.	Focus bears S	Heave to on starb'd tack	Heave to on starb'd tack
" NW	" SW	" "	" "
" N..	" W	" "	" "
" NE.	" NW	" "	Run 50 miles SW and heave to.
" E ..	" N	" "	Heave to on starb'd tack
" SE.	" NE	Run 50 miles NW and heave to	" "
" S ..	" E	Heave to on starb'd tack	" "
" SW.	" SE	" "	" "

The Thermometer: its Uses.

Fahrenheit's Thermometer is used on board ships for the purpose of ascertaining the temperature of the ocean at the surface, and of the air on the ocean.

The Thermometer is a most useful instrument to give warning of the ship's approach to ice in thick, foggy weather. This is known by plunging the Thermometer into a bucket of water, drawn from along side, at regular intervals during the day, and noting the readings.

In a locality where ice may be expected to be fallen in with, should the mercury in the tube keep sinking, we may conclude that the ship is approaching ice. If it be in the winter season, and the Thermometer has fallen to 34°, she will then be only half a mile from the ice. If in the summer, and the Thermometer has fallen to 42°, she will then be the same distance off. On a nearer approach the mercury falls still lower. When the ship has passed the ice, the Thermometer again rises. The temperature of the ocean is higher in deep water than in shoal water near the land or on banks. On approaching land, the Thermometer falls from 2° to 6°, except with deep water near a high bold shore, when the change is not so apparent. The temperature as indicated by the Thermometer is also used in connection with Barometric indications in judging the weather.

The Barometer: Barometric Indications.

On board ships, the Barometer is relied on for the purpose of foretelling the state of the weather. Confined in a frame, is a glass tube containing a column of mercury, which is acted upon by the pressure of the atmosphere; to the frame is attached a scale, marked in inches, and a sliding vernier, the top of which being set at the height of the mercurial column, gives the

measurement, in inches and hundredths parts of an inch. In north latitude, it stands highest with N.E. winds, and lowest with S.W. In south latitude, it stands highest with S.E. winds, and lowest with N.W. About the commencement of a storm in north latitude from the S.W. with rain, the Barometer falls, and continues to fall as the storm increases; when it stops and begins to rise, the rain will soon cease, and a shift of wind to the north may be looked for; it may, however, continue to blow hard until the Barometer rises to thirty inches.

In south latitude, N.W. winds bring rain, with a falling Barometer, but it rises with S. winds. It should always be remembered that the state of the air as indicated by the Barometer, *foretells coming weather*, rather than shows the present: this invaluable fact is often overlooked. The longer the time between the Barometric signs, and the change foretold by them, the longer such altered weather will last, and on the contrary, the less the time between the warning and the change, the shorter will be the continuance of such foretold weather.

The following remarks apply more particularly to northern latitudes.

The *Barometer and Thermometer should be noticed in connection;* if the Barometer has been about its ordinary height, say near thirty inches (at the sea level), and is steady, or rising, while the Thermometer *falls*, and dampness becomes less, N.W., N., or N.E. winds may be expected. On the contrary, if a fall takes place with a *rising* Thermometer, and increased dampness, wind and rain will surely follow from the S.E., S., or S.W. A fall of the Barometer, with a low Thermometer, foretells snow in high latitudes. Exceptions to these rules occur, when a N.E. wind (with rain, hail, or snow) is impending, before which the Barometer often rises (on account of the coming wind alone); this often deceives persons who expect fine weather from a "rising glass." When the Barometer is rather below its ordinary height, say down to 29.5 inches, at sea level, a rise foretells less wind, or a change in its direction towards the northward, or less wet weather, but, when it has been very low, say 29 inches, the first rising usually precedes or indicates *strong* winds, and at times heavy squalls from N.W., N., or N.E., after which violence a gradually rising glass foretells an improvement in the weather, if the Thermometer *falls;* but if the warmth continue, the wind will back round more southerly, or southwesterly, and blow, especially if the Barometer rise suddenly. The most dangerous shifts of wind, or the heaviest northerly gales, happen soon after the Barometer rises from a low point, or, at a later period, if the wind veers gradually. Indications of approaching changes of weather, and the direction of winds, are shown less by the height of the Barometer than by its falling or rising. Nevertheless, a height of more than thirty inches (30.0), is indicative of fine weather and moderate winds, except from east to north, occasionally. The Barometer

is said to be falling when the mercury in the tube is sinking, at which time its upper surface is somewhat concave or hollow, or in Aneroids, when the hand moves to the left. The Barometer is rising when the mercurial column is lengthening, the upper surface then being convex or round, or when the hand of the Aneroid moves from left to right. A *rapid rise* of the Barometer always indicates unsettled weather; a slow movement, the contrary, as likewise a steady Barometer, which, when continued with dryness of the air, foretells very fine weather. A *rapid* and *considerable fall*, foretells stormy weather, rain or snow. *Alternate rising and falling* (sometimes called pumping) indicates very threatening and unsettled stormy weather. The greatest depressions of the Barometer are with gales from the S.E., S., or S.W. The greatest elevations with wind from N.W., N., or N.E., or with calm. Though the Barometer generally falls with southerly, and rises with northerly winds, the contrary sometimes occurs, in which cases the southerly wind is usually very violent, and accompanied by rain or hail; perhaps with lightning. When a Barometer sinks considerably, much wind, rain or snow will follow, with or without lightning. The wind will be from the northward if the *Thermometer* is low, or from the southward if the Thermometer is high (for the season of the year). A *sudden fall* of the Barometer, with a present westerly wind, will be followed by a violent gale from N.W., N., or N.E. If a gale sets in from E., or S.E., and the wind veers by the S., the Barometer will continue falling until the wind is near a marked change, when a lull *may* occur, after which the gale will be renewed, perhaps suddenly and violently, and the veering of the wind towards the N.W., N., or N.E., will be indicated by the rising of the Barometer and the falling of the Thermometer.

The Coast Survey reports that *N. W.* winds on the North Pacific Coast, are *not* usually predicted by the Barometer, but from the S.E. almost invariably, the mercury falling one inch from its usual height of thirty inches.

The Aneroid Barometer.

The indications given by the Aneroid, are the same in fact as those by the Mercurial column. Its action is governed by atmospheric pressure upon a thin metallic case hermetically sealed, in which has been created a vacuum. The contraction and expansion of this case acts upon a metallic spring, which, connected with certain works, regulates the movements of the hand. The inches and hundredths are read off from the circular scale, in the same manner as are those of the Mercurial Barometer, the hand indicating the figures. This instrument is very sensitive and exact—and is a safe guide at times—when by the violent motion of the vessel, the plunging of the mercurial column renders the marine Barometer comparatively useless.

The Chronometer.

The chronometer is a superior kind of watch, and its advantages for measuring time more accurately are derived from its excellent construction, reduced friction from its peculiar make, and being supplied with a compensation balance, which, when properly adjusted, counteracts the effect of temperature. The reputation of the maker is, generally, the only guarantee the purchaser can have for the satisfactory performance of the instrument.

The best position on shipboard for the chronometer, is as near the center of motion, and as much removed from liability to shocks and change of temperature, as possible. It should be placed in a case firmly secured, resting upon and surrounded by curled hair or other elastic material.

Magnetism affects the rates of chronometers. It is, therefore, essential that nothing magnetic be placed near them, and they should remain in whatever position they are first placed: the magnetic action of the iron on board vessels is sometimes apt to affect the balance. The principal cause, however, of alteration in the rates of chronometers is change of temperature; to obviate this, some surveying vessels keep the temperature of the chronometer-room equable by means of lamps. The rates do not always change immediately, but sometimes at a considerable interval after the change of climate.

If there is but one chronometer on board, it should never be taken from its place in the cabin, for the purpose of marking time for observations; a watch with a second hand may be used to mark the time, being compared with the chronometer, before and after the observation. If there are more than one, the one moved should be compared, before and after moving, with another, to ascertain whether its rate has been disturbed. It has been found by experience that the motion of a chronometer is frequently accelerated, after being received on board, whereby a gaining rate will be increased and a losing one diminished. This effect has been ascribed to the magnetic action exerted by the iron in the vessel, on the inner rim of the balance, which is made of steel. When the rate has been accelerated, the longitude resulting from observations made with it will be to the westward of the true longitude; when retarded, to the eastward. The *stay* should always be carefully set before moving a chronometer, as they are often injured by neglect of this precaution. It should be wound up at a regular hour each morning, so that the same parts may undergo the same constant action. The rate generally changes after a chronometer has been permitted to run down. After winding, always look at the face to see that it has not stopped, and also at the index to be certain that it is *wound up;* for it is not uncommon for careless or inexperienced persons to turn the ratchet-key the wrong way, leaving the chronometer unwound. When a chronometer is wound, after running down, it is set a-going by giving it a small horizontal rotary mo-

tion—first taking the precaution to set the *stay*. Chronometers are sometimes liable to jump one or two seconds in the daily rate without any apparent cause, and then resume their former rate in a few days: they should be compared or rated at every port where reliable opportunity may offer.

The Greenwich Date.

Much needless confusion has been produced by the introduction into treatises on Navigation of three distinct modes of reckoning time, viz: Sea, Civil, and Astronomical Account. The *Civil day* begins at midnight and ends the following midnight; the first twelve hours are marked A.M., the last twelve hours P.M. The *Astronomical day* begins at noon, twelve hours *after* the Civil day commences; the hours are numbered from one to twenty-four, in numerical succession. The use of Sea Account, being productive of much inconvenience, has been abandoned in the U. S. Navy. All the calculations of the Nautical Almanac are adapted to *Astronomical* time at *Greenwich:* it consequently becomes necessary to know the *Greenwich date,* (Greenwich date is adopted as expressing both day and hour) or *Astronomical day and hour at Greenwich,* when the observation was taken. The Greenwich date is always given in *mean time,* except the contrary is expressed.

The rule for turning Civil into Astronomical time is: "If the Civil time be A.M., take one from the date and add twelve to the hours, and the result will be the Astronomical time wanted; if the Civil time is marked P.M., discard the designation P.M. and the Astronomical time is had without further change." Thus, January 2d, four hours, A.M., Civil time, is January 1st, sixteen hours, Astronomical day; and January 2d, four hours, P.M., Civil day, is January 2d, four hours, Astronomical day.

TO FIND THE GREENWICH DATE WITHOUT THE CHRONOMETER.

In *West Longitude* find the *Astronomical* date and *add* to it the Longitude in time; if the sum exceed 24 hours, deduct 24 hours and reckon the time the *next* day.

Example 1.

Required the Greenwich date, June 1st, 9 h. A.M., Civil time, in Longitude 76° 30′ W.

	H.	M.	
Civil time, June 1st.....	09	00	A.M.
Add.....	12	00	
Astronomical date, May 31st.....	21	00	
Longitude 76° 30′ W. in time, add	5	06	
	26	06	
Subtract....	24	00	
Gives Greenwich date, June 1st...	2	06	

Example 2.

Required Greenwich date, June 1st, 9 h. P.M., Civil time, in Longitude 76° 30′ W.

In this case, P.M., Civil date, is—

	H.	M.
Astronomical date, June 1st.....	09	00
Longitude 76° 30′ W. in time, add	05	06
Gives Greenwich date, June 1st...	14	06

In *East Longitude*, from the Astronomical date *subtract* the Longitude in time; if the Longitude in time be *greater* than the Astronomical date, *add* 24 hours to the latter and reckon it the *preceding* day.

Example 1.

Required Greenwich date, May 15th, 7 A.M., Civil time, in Longitude 67° 30′ E.

	H.	M.
Astronomical date is, May 14th.....	19	00
Longitude 67° 30′ E. in time, subtract	4	30
Gives Greenwich date, May 14th...	14	30

Example 2.

Required Greenwich date, October 1st, 3 hours 45 minutes P.M., Civil time, Longitude 110° E.

	H.	M.
Astronomical date, October 1st....	03	45
Add.....	24	00
	27	45
Longitude 110° E. in time, subtract.	7	20
Gives Greenwich date, Sept. 30th...	20	25

When it is Noon at the Place—In West Longitude, the *Greenwich date* is the Longitude in *time;* in East Longitude, *subtract* the Longitude in time from 24 hours, the remainder is the Greenwich date the *preceding* day.

The *Greenwich date*, by the methods which have been given, will show whether the Chronometer is A.M. or P.M., viz:

If the Greenwich date (or Astronomical time) be *less* than 12 hours, the Chronometer shows P.M., but if *more* than 12 hours, the excess is so much past midnight or A.M.

To find the Sun's Declination from the Nautical Almanac.

Find the Greenwich date; take from the "Nautical Almanac" the declination for apparent noon and the hourly difference; if the declination is increasing, mark the difference + (add), if decreasing, — (subtract). Reduce the time to hours and decimal parts of an hour, and multiply the hourly difference by it; reduce the product to minutes and seconds, and *add* it to, or *subtract* it from, the declination at noon, as indicated by the sign:

Example 1.

Required the Sun's declination, at noon, November 6th, 1868, in Longitude 153° 45′ West.

	H.	M.
Local Astronomical date is, November 6th	00	00
Longitude 153° 45′ West, in time, add	10	15
Greenwich date is, November 6th	10	15

Hourly difference	44″.6	⊙ Declination	16° 09′ 45″
Hours, Greenwich time, and decimal parts	10.25	Declination increasing, add	7 37
	2230	Required declination	16 17 22
	892		
	446		
	60)457.150		
	7′ 37″		

Example 2.

Required Sun's declination, January 9th, 1868, at 9 A.M., Longitude 97° 08′ East.

	H.	M.
Local Astronomical date is, January 8th	21	00
Longitude 97° 08′ East, in time, subtract	6	30
Greenwich date is, January 8th	14	30

Hourly difference	19″.8	⊙ Declination	22° 18′ 05″
Hours, Greenwich time, and decimal parts	14.5	Declination decreasing, subtract	4 47
	990	Required declination	22 13 18
	792		
	198		
	60)287.10		
	4.47		

The Equation of Time.

Find the *Greenwich date,* take the Equation of time and hourly difference from the "Nautical Almanac," reduce the time to hours and decimal parts, and multiply the hourly difference by it; *add* the product if the Equation is *increasing, subtract* if *decreasing.*

Required Equation of time corresponding to date and Longitude given in Example 1, for finding the Sun's declination:

	H. M.
Greenwich date, November 6th, is	10 15

	S.		M. S.
Hourly difference	0.13	Equation of time	16 13.1
Hours, Greenwich time, and decimal parts	10.25	Equation decreasing, subtract correction	1.3
	65	Equation required	16 11.8
	26	To be subtracted from apparent time.	
	13		
	1.3325		

Required Equation of time corresponding to date and Longitude given in Example 2, for finding the Sun's declination:

	H. M.
Greenwich date, January 8th, is	14 30

	S.		M. S.
Hourly difference	1.06	Equation of time	6 46.5
Hours, Greenwich time, and decimal parts	14.5	Equation increasing, add correction	15.4
	530	Equation required	7 01.9
	424	To be added to apparent time.	
	106		
	15.370		

Of the Gain and Loss of Time in Circumnavigating the Globe.

A ship sailing *east* or *west* from any meridian, and returning to that meridian after having circumnavigated the globe, will be found to have *gained* or *lost* twenty-four hours of time.

Thus, sailing *west*, say from the meridian of Greenwich, when the ship has made 15° of longitude, the *mean time* will be found to be one hour *behind* that of the Greenwich *Chronometer time;* continuing her course west until she reaches the longitude of 180° west, she will have *lost twelve hours;* still proceeding westward, she is now in *east* longitude, and the longitude is decreasing; when she again arrives at the meridian of Greenwich, she will be *twenty-four hours behind time*, or have lost *one entire day*. Hence, when crossing the meridian of 180° west, *one day* must be *discarded*. Thus: should we pass 180° west on *Sunday, January 5th*, the *next* day must be called *Tuesday, January 7th*.

When sailing *east*, under like circumstances, when 15° of longitude have been made, the mean time at ship will be one hour *ahead* of Greenwich Chronometer time. When arrived at 180° *east*, the time at ship will be twelve hours in *advance* of the Chronometer. Passing the meridian of 180° east into west longitude, and continuing eastward, we decrease our longitude, until having arrived again at the meridian of Greenwich, we find that we have *gained twenty-four hours* on the voyage.

Hence, when coming to 180° east and crossing to west longitude, *one day* must be counted *twice*. Thus: should we pass the meridian of 180° east on *Sunday, January 5th*, the *next* day must likewise be called *Sunday, January 5th*.

To find the Longitude by Chronometer, at Noon, from Equal Altitudes of the Sun.

A.M. Observe an altitude of the Sun about thirty minutes from noon, note the altitude and the time of observation by Chronometer.

P.M. Clamp the index of the sextant or quadrant at the same altitude as observed before noon, and when the Sun falls to it, again note the time by Chronometer.

Add together these two Chronometer times and find half their sum; to this half-sum apply the Chronometer error as usual; the result will be the *Mean Greenwich time;* to this Greenwich time apply the Equation of time corrected the *contrary way* as indicated in the "Nautical Almanac," and the product will be the Greenwich *apparent time*, which in *West Longitude* is the Longitude in time at *apparent noon*, corresponding to the time at which the meridian observation is taken for Latitude.

Example.

April 20th, 1868 (Civil day). Before noon the altitude of the Sun's lower limb was observed to be 67° 58′; time by Chronometer, $8^h\ 19^m\ 15^s$. When the Sun fell to the same altitude after noon, the time by Chronometer was $9^h\ 23^m\ 21^s$. Chronometer slow, $2^m\ 15^s$. Required the Longitude.

	H. M. S.		S.
A.M. Time by Chronom.	8 19 15	Hourly diff. Nautical Almanac	0.53
P.M. Time by Chronom.	9 23 21	Greenwich hours.....	9
Sum.....	17 42 36	Correction of Equation.....	4.77
			M. S.
Half-sum.....	8 51 18	Equa. Nautical Almanac..	1 13.9
Chronometer slow, add...	2 15	Equa. *increasing*, add	4.8
Greenwich mean time....	8 53 33		1 18.7
Equation of time, directed *subtract*, hence, *add*.....	1 19		
Greenwich apparent time at apparent noon at ship, and is the Longitude in time.....	8 54 52 = 133° 43′ West Longitude.		

In *East* Longitude, the *difference* between *apparent* noon at the ship and the Greenwich time by Chronometer, reduced to *apparent time*, is the *Longitude* in *time*.

Example.

April 4th, 1868. Before noon the altitude of the Sun's lower limb was observed to be 86° 10′; time by Chronometer, $1^h\ 50^m\ 0^s$. When the Sun fell to the same altitude after noon, the time by Chronometer was $2^h\ 16^m\ 0^s$. Chronometer fast, $1^m\ 10^s$. Required the Longitude.

	H. M. S.		S.
A.M. Time by Chronom.	1 50 00	Hourly diff.Nautical Almanac.	0.74
P.M. Time by Chronom.	2 16 00	Greenwich hours	2
Sum.....	4 06 00	Correction of Equation	1.48
			M. S.
Half-sum.....	2 03 00	Equa. Nautical Almanac..	2 54.9
Chronometer fast, subtract.	1 10	Equa. *decreasing*, subtract..	1.5
Greenwich mean time....	2 01 50		2 53.4
Equation of time, directed *add*, hence, *subtract*....	2 53		
Greenwich apparent time.	1 58 57		
Apparent noon at ship ...	12 00 00		
Difference is Long. in time	10 01 03 = 150° 15′ 03″ East Longitude.		

NOTE.—When a ship is making much northing or southing in the interval between the altitudes, if sailing *towards* the Sun, after having noted the Chronometer time, *increase* the A.M. altitude by advancing the index of the instrument equal to the difference of Latitude made in the interval; sailing *from* the Sun, *decrease* the A.M. altitude by moving the index back, equal to the difference of Latitude made in the interval, noting the time for the same altitude P.M. without further correction.

To find the Apparent Time and Longitude by Chronometer at Sunrise and Sunset.

RULE.

Observe with a spy-glass the instant the upper or lower limb of the Sun touches the horizon, and note the time by the Chronometer.

Bring the latitude forward to the time of observation, correct the declination, and find the Polar distance, as in ordinary cases.

When the *lower limb* is observed, take the *difference* between the Sun's semi-diameter (N. A.) and the refraction, (Table XII, Bowditch) for 00° 00′ alt., from which *subtract* the parallax for 00° 00′ alt. (Table XIV, Bowditch). To this *add* the dip of the horizon (Table XIII, Bowditch) corresponding to the height of the eye above the sea level. The result constitutes a correction, usually about 22′, which must be *subtracted* from the sum of the latitude and Polar distance, and *added* to the half-sum.

When the *upper limb* is observed, *add* together the refraction *less* the parallax, the Sun's semi-diameter, and the dip of the horizon. This correction is usually about 54′, and is also *subtracted* from the sum of the latitude and Polar distance, and *added* to the half-sum.

The *apparent time* is found by the rule given on page 208 (Bowditch), for working the time by the tables, and the *longitude* by turning the difference between this time and the Greenwich date into degrees and minutes; except great accuracy is required, the application of 22′ as a correction for the Sun's *lower* limb, and 54′ for the *upper*, *subtracted* and *added* as above directed, will give an approximate result.

Example.

December 10th, 1868. Civil time in latitude 42° 00′ north, and longitude 135° 00′ west, the Sun's *lower* limb was observed to set at $4^h\ 30^m$ P.M. Time by Chronometer, $1^h\ 30^m\ 00^s$; error, $4^m\ 00^s$ fast; height of eye, 30 ft. Required the apparent time and longitude.

	′ ″
Refraction ...	33 00
Sun's S. D. .	16 17
	16 43
Parallax	9
	16 34
Dip.....	+ 5 23
Correction ...	21 57

	H. M. S.
App. time of obs...	4 30 00
Long. 135° W., in time.....	+ 9 00 00
Greenwich date...	13 30 00
Declination.....	22° 58′ 45″ S.
Increasing, add cor.	2 53
Correct declin'n	23 01 38 S.
	90
Polar distance..	113° 01′ 38″

Hourly dif. declination	12″.8
Greenwich hours and parts.....	13.5
	640
	384
	128
	60) 172.80
Correct declination .	2′ 52″.8

	° ′		
Sun's altitude	00 00		
Latitude	42 00	secant...	0.12893
Polar distance.....	113 02	co-secant	0.03608
Sum.....	155 02		
Correction	— 22		
	154 40		
½ sum.....	77 20	co-sine..	9.34100
Correction.....	+ 22		
	77 42	sine.....	9.98991
			19.49592

Hourly difference, equation .	1ˢ.15
Greenwich hours and parts .	13.5
	575
	345
	115
Correction	15ˢ.525

	H. M. S.
Time by Chron.	1 30 00
Chr. fast, subtract	4 00
	1 26 00
Add.....	12
Greenwich mean time..	13 26 00
Time at ship ...	4 25 46
Long. in time...	9 00 1½ = 135° 03′ 02″ W.

9.74796 = 4ʰ 32ᵐ 17ˢ apparent time.

	M. S.
Equation	6 46.4
Decreasing, subtract.....	15.5
Corrected equation	6 30.9

6 31 equation.

4ʰ 25ᵐ 46ˢ mean time.